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Your Plans and Theirs

A manufacturing concern wisely, either continuously or intermittently, uses the services of consultants, but it still retains the overriding conduct of its own business. This is due to the simple fact that it knows its own business better than any outsider. A report, setting out a mechanised system of production, has to be considered in relation to the capital structure of the concern; variation in demand for its product and so forth, whilst one on marketing must be correlated with production capacity and the like.

To our mind, the proposed functions of the Iron and Steel Board seem to be those of an official but unpaid firm of consultants, and it is just as well to regard it from this angle. The high grade consultant will refuse to act unless he feels reasonably well assured that his advice will be of real benefit to his client. Before he makes a decision, however, he will require some basic data. It is on these grounds that we ask all ironfounders to tell the Board as much about themselves as possible, because the overall picture to be presented, will be so complex that the Board, if they be honest as we sincerely believe them to be, will not be in a position to do more than indicate to the industry as a whole a series of generalised recommendations, directed towards raising the level of the standing of the industry in relation to others. No honest consultant could possibly produce a report upon which action could be taken, when the problem relates to concerns making products ranging from an ounce to 150 tons in weight, or employing one to a thousand or more operatives.

The requirements for the rationalisation of a shop doing both iron and brass castings and located in a back street of a large city, are quite different from the country town jobbing shop apparently doing the same class of work. In the past, there was a legal difference between a workshop and a factory. That difference, but with no real line of demarcation, still persists in spite of the law, and the " workshops " variety of foundry even now constitutes a large and important section of the industry. Generally speaking, the workshops are ancillary to, and not in competition with, the larger concerns. They have one thing in common and that is they all exist by giving service, for to paraphrase the Qualcast Service Code, the customer in the end pays the wages of the supplying concern.

A factor, not properly appreciated in Whitehall, is that probably every firm in the industry is ambitious, and for the achievement of those ambitions has a plan—may be on paper, or may be in the dreams of the proprietor or chief executive. Free from frustration, a proportion of these would translate themselves into action, exactly as they have done in the past. This is not good enough for the Government, as it, too, is planning to plan, and as it officials learn of the ambitions of every unit in the industry, it is probable that they will align themselves with the general trend and take credit for it.

It is true to say that the Factory Acts have, generally speaking, been based on the practice existing in more enlightened firms. Thus, the Government would be well advised not to legislate for the iron foundry industry as a whole, but to enact provisions suited to each class of shop. A minimum should be imposed on the smallest shops, just as the self-employed shopkeeper is regarded as being in a different category from the large multiple store. We emphasise again, that these self-imposed consultants must be made aware of the great diversity of the industry and only the actual foundry owners can tell them. Not a few foundrymen have expressed a desire to go overseas. Such ambitions might also be usefully disclosed to the authorities.

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FORTHCOMING EVENTS

(Secretaries are invited to send in notices of meetings, etc., for inclusion in this column.)

FEBRUARY 7.

Manchester Association of Engineers :—" Mining Equipment," by E. F. Owen. At the Engineers' Club, Albert Square, Manchester, at 6.45 p.m.

Scottish Engineering Students' Association :—" The Training of Engineers," by J. E. Sansom. At the Heriot-Watt College, Edinburgh, at 7.15 p.m.

Institute of Mechanical Engineers :—" Automatic Control Systems," by Prof. A. Porter. At Storey's Gate, St. James Park, London, S.W.1, at 5.30 p.m.

FEBRUARY 11.

Metallurgical Association :—" Statistical Sampling Plan for Refractory Products," by W. T. Hale. At 198, West Street, Sheffield, at 7 p.m.

FEBRUARY 12.

Institute of Physics :—" Physics and Steel Making," by Dr C. Sykes, at Sheffield University, at 5.15 p.m.

Institute of British Foundrymen

FEBRUARY 8.

West Riding Branch :—Visit to Hadfields, Limited, Sheffield, arriving at 3 p.m. Lecture : " Steel Foundry Practice."

FEBRUARY 15.

West of England Branch :—" Cupola Practice," by C. A. Payne, at Grand Hotel, Broad Street, Bristol, at 3 p.m.

PUBLICATIONS RECEIVED

Qualcast Service Code. Published by Qualcast, Limited, Derby.

The matter of this pamphlet is based on the simple notion that the wages of the employees of any company are paid by the customer and that customers will only remain customers so long as their suppliers' goods are better value to them than those they can buy elsewhere. It has been issued to every employee and the simple language used reinforces the essential logic of the appeal to produce more and more goods of ever-increasing quality. It is of such excellence that it is worthy of a much wider circulation, for it expounds the essentials for getting this country out of the mess in which it now finds itself, essentials which are not yet appreciated by the *hoi polloi*. The Government would be well advised to adopt the slogan: " The customer pays your wages."

Data Sheets. Alar, Limited, of 35, New Broad Street, London, E.C.2, have just published two further data sheets covering aluminium casting alloys L.A.C. 113B (Al-Zn-Cu) and " Y " alloy. Details are given of composition; mechanical properties; strength at elevated temperatures; physical properties; corrosion resistance and other characteristics. They are uniform with earlier publications and prepared for inclusion in loose-leaf binders. They are available to readers on application to Alar.

Greater Production or a Lower Level of Life, by the Rt. Hon. J. R. Clynes, P.C., D.C.L. Published by Aims of Industry, 12, Carteret Street, London, S.W.1. Price 3d.

In this pamphlet, the Author, a veteran Statesman, with the experience of life-time as a trade union official, makes a serious and logical appeal to employees to produce more goods as a means of getting better value for their wages.

MANGANESE IN MANGANESE STEEL

N. A. Ziegler, W. L. Meinhart and J. R. Goldsmith, who presented a Paper on " The effect of manganese in the properties of cast carbon and carbon molybdenum steel " to the annual meeting of the American Society for Metals, have summarised their results in the following statement.

The effect of manganese on structural and thermal characteristics, as well as on the physical properties of " plain carbon " and carbon-molybdenum cast steels of three different carbon contents, has been investigated. It was found that manganese increases the thermal sluggishness and air hardenability of all of them. This increase, however, is much more gradual and less pronounced than in the case of chromium-molybdenum or chromium-nickel-molybdenum steels. Fully developed, suppressed transformations on relatively slow cooling, associated with more or less considerable " air hardenability," can be observed only when manganese content increases to about 2 per cent. This increase in thermal sluggishness as a function of increasing manganese is more pronounced in " carbon-molybdenum " than in " plain carbon " steels, and in " higher " carbon than in " low " carbon steels.

By raising the manganese content to about 1.5 per cent. in " plain carbon " and to about 0.75 to 1.0 per cent. in " carbon-molybdenum " steels, the strength can be increased about 20 per cent., as compared to similar steels containing about 0.5 per cent. manganese. At the same time, the decrease in ductility is slight. The impact resistance with the above manganese contents is at its highest, as compared with that obtained with either lower or higher percentages.

Some welding experiments indicate that there are no welding difficulties encountered within the carbon range used, provided the manganese content is held under 2 per cent. The resultant weld assemblies in steels containing under 2 per cent. manganese, exhibit considerable ductility and strength. No excessive hardness was developed in the affected zones of these steels.

B.S.I. STANDARDS

The Monthly Information sheet issued by the British Standards Institution, of 28, Victoria Street, London, S.W.1, lists the following amongst new work started:—

(*a*) Numbering of cylinders in internal-combustion engines;

(*b*) Dimensions of grinding wheels and method of attachment (revision of B.S. 620);

(*c*) Asbestos cement spigot and socket flue pipes and fittings for gas-fired appliances—dimensions and workmanship of (revision of B.S. 567);

(*d*) Asbestos cement flue pipes and fittings (heavy quality) for domestic heating stoves (revision of B.S. 835).

HOT-ROLLING OF IRON-CARBON ALLOYS WITH OVER 1·7 PER CENT. CARBON

By E. PIWOWARSKY and A. WITTMOSER*

IT is generally acknowledged by both foundrymen and users that high-duty cast iron possesses characteristics, such as high damping capacity, low notch-sensitivity and good corrosion- and wear-resisting properties, which will ensure its employment for an ever-widening range of uses in the course of the next few decades. A still wider field would, however, become opened up to this class of cast iron if it could be made capable of plastic deformation and as a result sustain a marked improvement in both static and dynamic properties, as has proved feasible with almost all other industrial alloys.

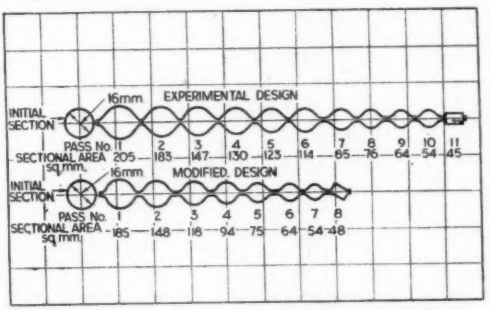
Judging from the recent literature, the prospects of realising a mechanical shaping of cast iron do not appear by any means dim. Not all foundrymen will be prepared to share this view, since the apparent inability of cast iron to respond to hot- and cold-working is still frequently given as one of the main differences between it and steel, and is, indeed, regarded as on a par with the difference in carbon content. We thus find that the Werkstoffhandbuch Stahl und Eisen[1] states that a carbon content of 1.7 per cent. roughly corresponds to the upper limit of forgeability, while R. Stotz[2] suggests that malleable iron also cannot be hot-worked to any considerable extent. Moreover, he considers this material forgeable only in highly-decarburised, thin sections.

Combination of Desirable Properties

In this connection, it may be noted that F. R. Bonte and M. Fleischmann[3] suggest the intentional production of a black-fracture steel with 1.6 per cent. C, and 1.2 per cent. Si, with the object of combining in one material the most desirable properties of both annealed steel and cast iron. The dividing line between "annealed wrought steel" and "forged and rolled cast iron" is thus seen not to be very sharp.

Furthermore, Ingberg and Sale,[4] on plotting stress-strain curves from compression tests on cast iron over a temperature range from 20 to 757 deg. C., found that the characteristics of the curves indicate a transition from a state of brittleness to one of incipient plasticity as the temperature is raised; this may already be construed as pointing to the possibility that cast iron can be successfully hot-rolled. Also, from investigations on the shrinkage of cast iron, Girault[5] concluded that cast iron could be forged at temperatures between 600 and 900 deg. C., especially above 700 deg.

The fact that cast iron can be successfully hot-worked and the technical significance of this were first recognised in all their implications by H. Nipper and E. Piwowarsky. In his patent specification of 1932,[6] H. Nipper enumerated the host of applications which a new material such as "rolled cast iron" would possess. His specification covers the hot-working of all iron-carbon alloys containing more than 1.7 per cent. carbon, in any structural condition and at temperatures in the range from 950 to 1,150 deg. C. The experimental work on which this specification was based, and subsequent work by Nipper and Piwowarsky,[7] have already been described. In these investigations, in which white, grey and mixed irons were submitted to rolling, annealed and/or white irons were found the easiest to roll and gave the highest ultimate physicals. Rolled malleable iron gave tensile values up to 120 kg. per sq. mm., with low elongation values. It may be noted that the cast irons investigated were low in phosphorus, *viz.*, 0.05 per cent.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SECTIONAL AREA sq.mm.
205 185 147 130 123 114 85 76 64 54 45
INITIAL SECTION
16mm
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1 2 3 4 5 6 7 8
SECTIONAL AREA sq.mm.
185 148 118 94 75 64 54 48

FIG. 1.—ROLL DESIGNS FOR ROLLING CAST IRON.

Work on similar lines has been carried out both in the United States and Britain. D. P. Forbes[8] rolled grey and white irons between flat rolls and found that white iron bars could be rolled down to sheet gauges. In his Paper, Forbes gives no details of the procedure by which this was achieved. He noted that hot-rolling promoted to a marked degree breakdown of the cementite, but he did not consider there was much prospect of successfully rolling the grey irons.

Review of Progress in Hot-rolling

J. V. Murray[9] carried out some rolling experiments on pearlitic, annealed malleable irons and found that the optimum rolling temperature was around 950 deg. C. At this temperature, the test-bars could be reduced by 80 per cent. in cross-section with one reheat in eight passes. But the tensile strength of the rolled products was only 60 kg. per sq. mm.

In 1942. E. Piwowarsky[10] reviewed the progress which had been made in the hot-rolling of cast iron,

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and expressed the view that rolled cast iron was in a position to provide a very useful structural material combining the mechanical properties of steel with those of graphitic cast iron. In consequence, its range of applications may be regarded as almost unlimited.

It may therefore be concluded from the literature that high-duty cast irons with different compositions and structures can be hot-rolled provided certain conditions are met. It is striking that no systematic investigations have been made to develop this potentiality; for example, by a closer study of the influence of chemical composition, initial structure, conditions and rate of rolling, etc., on the properties of the rolled product. Published work has been mainly limited to exploratory experiments and only the briefest indications are given of the conditions under which the material tested was rolled. The present Authors' in-

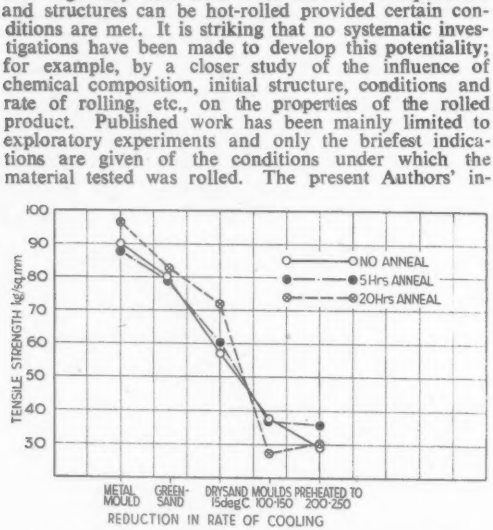

FIG. 2.—TENSILE STRENGTH PLOTTED AGAINST RATE OF COOLING OF MOULD.

vestigations, summarised below, are intended to fill the existing gaps in the knowledge of the precise effects of these variables and to demonstrate that the rolling of cast iron, to be successful, must satisfy certain *a priori* requirements in order to assure a satisfactory reproducibility in the results.

The Authors' experiments were designed to establish the conditions governing the rolling of iron-carbon alloys with over 1.7 per cent. C. In preliminary tests, an alloy containing 2.8 per cent. C, 1.1 per cent. Si, 0.6 per cent. Mn, less than 0.03 per cent. S and 0.05 to 0.4 per cent. P, had been found to respond satisfactorily to rolling; this led the Authors to adopt this composition as the standard composition in their subsequent work.

Rolling Variables

The rolling variables studied were: (1) The effect of initial structure; (2) the effect of rolling temperature, and (3) the effect of the speed of rolling; the compositional variables were: (*a*) The phosphorus content, and (*b*) the carbon content above 1.7 per cent. Other factors which might have a bearing on the rolling properties were also noted in the course of this work.

Heats were prepared in a small Junkers-type graphite-rod furnace, and bars measuring 16 mm. in diameter and 200 mm. long were cast in sand and metal moulds. About 40 bars were cast from each heat. The furnace was tapped with the metal at a temperature of about 1,450 deg. C., the metal at pouring being about 1,350 deg. C. Bars were X-rayed to detect any shrinkage cavities, and any bars found defective were discarded. Some bars from each batch were reheated in an electric furnace to eliminate casting stresses and to initiate breakdown of the cementite. The same furnace was used for reheating the bars to rolling temperature.

The bars were rolled in a pinion stand with three-stage control, permitting rolling speeds to be varied from 0.5 to 10 m. per sec. The reheating furnace was located close enough to the stand to allow the rolling temperature to be taken roughly as equal to the furnace temperature.

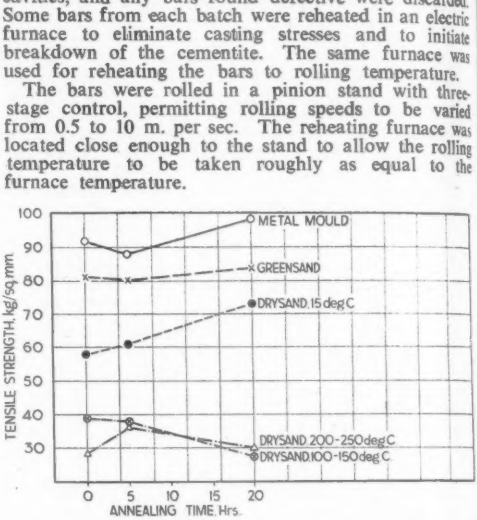

FIG. 3.—RELATIONSHIP BETWEEN TENSILE STRENGTH AND ANNEALING TIME.

While flat rolls had been used in previous work on cast iron, the rolls in the Authors' experiments were grooved. Roll barrels were 280 mm. in diameter and 300 mm. wide. The first roll design was developed by Dr. F. Grüner on the basis of a roll design intended for rolling alloy steels (Fig. 1, upper part). With these rolls the initial section of 16 mm. dia. was reduced in 11 passes to a section of 9 by 5 mm., an aggregate reduction of 78 per cent.

Before rolling, the cast and partly annealed bars were reheated in the electric furnace for 30 min. After each pass they were returned to the furnace for a further reheat of 3 min. and before each re-roll given a part turn to counteract spreading between the rolls.

After rolling, each bar measured 9 by 5 mm., and 1.2 m. long. Two samples were taken from each bar for etching (longitudinally and transversely), one sample for hardness tests (longitudinally), one for shear test (transversely) and four samples for tensile and elongation tests (longitudinally). At least five values were

averaged in each case to obtain the required mechanical data. On the whole, 40 heats were prepared and a total of two metric tons of cast iron was cast into 1,800 round bars and 20 flat bars.

Initial Structure

To examine the effect of initial structure on the mechanical properties, five sets of test-bars of similar composition were cast, and each series of bars submitted to three different heat-treatments. A range of structures from pure ledeburite to a coarse lamellar-pearlitic structure was thus produced by using different types of moulds, the annealing time also being varied to obtain a finer gradation of structure.

The five sets of bars were cast in: (1) Iron moulds; (2) green-sand moulds, and (3 to 5), dry-sand moulds, with sand temperatures of 15, 100 to 150, and 200 to 250 deg. C. respectively. Each series before testing was: (*a*) Left unannealed, or (*b* to *c*) annealed for five or 20 hrs. respectively at 875 deg. C. The bars were then rolled at 850 deg. C. at a speed of 3 m. per sec.

Marked differences in response to rolling were observed already in the first pass. As the rate of solidification of the cast bars diminished, the bars became less easy to roll. Bars cast in preheated sand moulds showed deep cracks and crumbled easily, while those cast in iron and green-sand moulds could be rolled without difficulty. The difference in annealing times did not appear to have any marked effect. This was shown quite clearly by the tensile values of the rolled bars (Figs. 2 and 3). The hardness and shear values showed the same limited effect of annealing time.

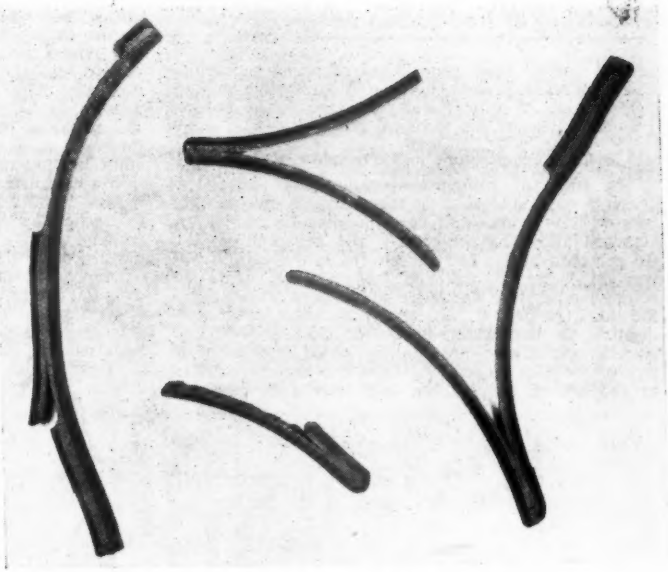

FIG. 4.—LONGITUDINAL SPLITTING OF BARS ON ROLLING.

FIG. 5.—TRANSVERSE CRACKS PRODUCED ON ROLLING.

Polished sections were prepared to study the structural changes from the initial cast to the finished rolled products. As expected, the iron-mould and green-sand castings were composed of pure ledeburite, and the proportion of graphite in the casting increased with the sand temperature. Both annealing temperature and rolling had a pronounced effect on the breakdown of the cementite, while rolling also produced a marked refinement of the matrix.

These investigations appear to indicate that the initial structure of the casting determines in a large measure the response of the metal to rolling, in spite of the identity in chemical composition. With increase in amount of the precipitated graphite in the initial material, rolling became easier, and the values of the mechanical properties of the rolled product showed a rapid diminution. High mechanical values after rolling, therefore, call for a ledeburitic structure in the initial casting, coupled with heat-treatment for

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several hours. High proportions of primary graphitic carbon already present in the original casting militate against ease of rolling, and make the rolled product practically useless for technical purposes.

Rolling Temperature and Phosphorus Content

The effect of rolling temperature and phosphorus content were studied simultaneously on five sets of bars with a composition corresponding to that of the standard alloy (2.8 per cent. C, 1.1 per cent. Si, and 0.6 per cent. Mn). The phosphorus in the various sets was 0.1, 0.25, 0.5, 0.8, and 1.3 per cent., while the rolling temperature was raised in stages of 50 deg. from 575 to 1,150 deg. C. To study the effect of annealing time the bars were annealed at 875 deg. for 5 and 20 hrs. respectively. As already stated, the temperature of the bars on removal from the furnace is taken as the rolling temperature, and after each pass the bars are reheated for a short time in order to maintain the requisite temperature throughout the rolling sequence.

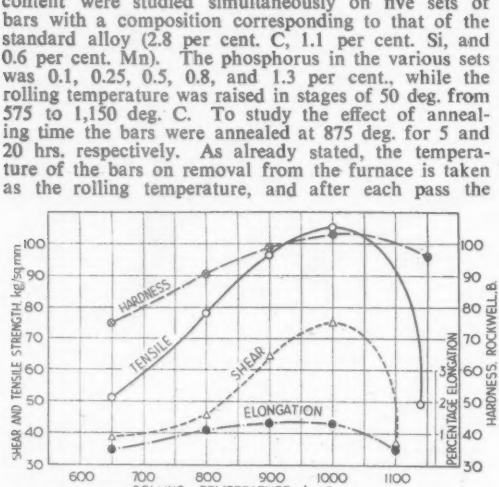

FIG. 6.—RELATIONSHIP BETWEEN MECHANICAL PROPERTIES AND ROLLING TEMPERATURE, 0.1 PER CENT. P IRON.

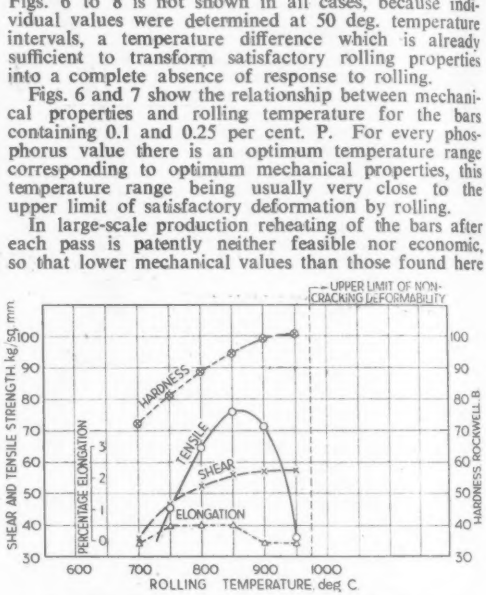

FIG. 7.—RELATIONSHIP BETWEEN MECHANICAL PROPERTIES AND ROLLING TEMPERATURE, 0.25 PER CENT. P IRON.

On the first pass already, the phosphorus samples clearly revealed the marked effect exercised by the rolling temperature. At the lower temperatures (575 to 750 deg. C.) some bars cracked badly and others even split right through. As the rolling temperature was raised, the bars showed a greater readiness to respond to rolling, until eventually satisfactory deformation without cracking was realised in each pass. At the highest rolling temperatures, between 850 and 900 deg., the bars again split badly, usually with great abruptness. Bars rolled either too cold or too hot are shown in Figs. 4 and 5. The mechanical properties did not indicate any specific effect of the differences in annealing times, the values for metal-cast and green-sand casts being practically identical, apart from normal scatter.

On the other hand, the curves in which mechanical values were plotted against rolling temperature disclosed how an increase in the rolling temperature results in a substantial improvement in the mechanical values, which, however, again diminish above a certain temperature as determined by the phosphorus content. The downward portion of the curves in Figs. 6 to 8 is not shown in all cases, because individual values were determined at 50 deg. temperature intervals, a temperature difference which is already sufficient to transform satisfactory rolling properties into a complete absence of response to rolling.

Figs. 6 and 7 show the relationship between mechanical properties and rolling temperature for the bars containing 0.1 and 0.25 per cent. P. For every phosphorus value there is an optimum temperature range corresponding to optimum mechanical properties, this temperature range being usually very close to the upper limit of satisfactory deformation by rolling.

In large-scale production reheating of the bars after each pass is patently neither feasible nor economic, so that lower mechanical values than those found here may be expected as a result of the unavoidable drop in temperature which will then occur in the rolling sequence. This was, in fact, found to be the case with bars of the low-phosphorus compositions which had good rolling properties, when they were heated to 1,000 deg. for the first pass and rolled down through all 11 passes without intermediate reheating.

Nevertheless, subsequent experiments showed that the temperature of the material at the last pass substantially determines the mechanical properties. The same physicals as obtained by reheating to the rolling temperature after each pass, can thus be realised by rolling the bars through 10 passes from an initial temperature of 1,000 deg. with intermediate reheating, but giving a final reheat to the optimum temperature before the eleventh and last pass.

The effect of the phosphorus content was very marked in all these tests. As anticipated, the mechanical properties diminished as the phosphorus increased from 0.1 to 0.8 per cent.; they then increased again slightly but unmistakably for the 1.3 per cent. P com-

position (Fig. 8). At the same time, the permissible rolling-temperature range was found to be somewhat greater for the bars containing 1.3 per cent. P than for those with 0.8 per cent. P. These conditions are clearly brought out in Figs. 9 and 10. The latter gives the average mechanical properties for all heats plotted against the phosphorus content, and brings out the unexpected reversal in the trend of tensile strength, shear strength, hardness and elongation values.

Speed of Rolling

As a lower rolling temperature resulted in lower mechanical properties, it seemed feasible to reduce the loss of heat during rolling by increasing the speed of rolling. Since alloy cast irons are more difficult to deform than steel, it was to be expected that the irons would not be able to cope with a higher rate of deformation and would split during rolling.

To see whether this would be the case, bars from four heats with 0.1, 0.5 and 0.8 per cent. P were rolled

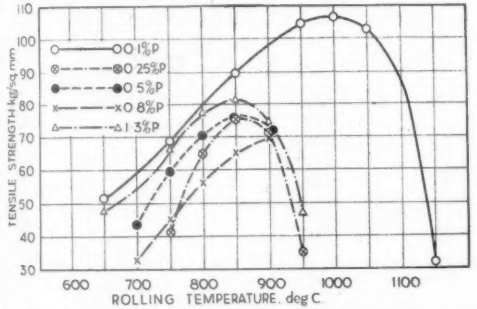

FIG. 8.—RELATIONSHIP BETWEEN TENSILE STRENGTH AND ROLLING TEMPERATURE, 0.1 TO 1.3 PER CENT. P IRONS.

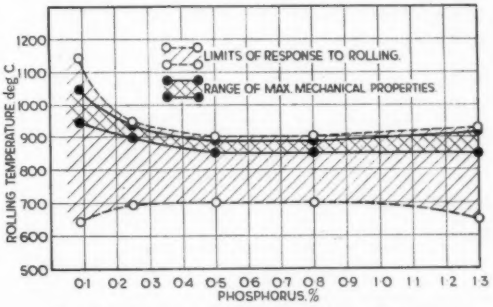

FIG. 9.—ROLLING RESPONSE AND MAXIMUM MECHANICAL PROPERTIES PLOTTED AGAINST TEMPERATURE AND PHOSPHORUS VALUES.

at various speeds between 0.5 and 10 m. per sec., raising the speed in stages of 0.5 m. per sec. The rolling temperature was 850 deg. in all cases. Against expectations, the speed of rolling proved to have practically no effect, and no splitting occurred, even at 10 m. per sec. Fracture tests and micro-examination also indicated no fundamental differences. This was further confirmed in mechanical tests, the physicals measured being almost constant over the whole speed range (Fig. 11).

Forging and Rolling Analogy

It may perhaps be concluded from these observations that cast iron of rolling quality can be rolled down to thin sheets and strip in continuous mills. From the analogy between forging and rolling, it appears that cast iron would also be susceptible to drop forging and pressing.

According to the literature and the Authors' own work, grey iron is much more difficult to shape by mechanical means than white iron. Investigation of the effect of initial structure had already shown that the mechanical values are rapidly reduced as the quantity of initial graphite increases. This seemed to indicate that the bad rolling quality of high-carbon grey iron may be due solely to the graphite already present. It therefore remained to be determined how high-carbon alloys in which an initial ledeburitic structure had become transformed by subsequent annealing with the conversion of increasing proportions of elementary carbon to graphitic carbon, would behave on rolling.

For these tests, four heats were prepared:—

(*a*) With low P (0.1 per cent.) and 3.1 and 3.7 per cent. C, and

(*b*) with high P (0.6 per cent.) and 3.3 and 3.5 per cent. C.

The metal was poured in green-sand and metal moulds, the former casts being mainly grey, and the latter white. On rolling, the grey bars behaved very badly, showed deep splits and soon crumbled. The white irons, on the other hand, responded well to rolling. Examination of the structure gave no indication of the mechanical properties which might be anticipated from these mould-cast high-carbon bars, but actual tests showed that, in spite of the initial white structure, the higher-carbon heats had lower physicals than the lower-carbon alloys.

The measured physicals are plotted in Fig. 12 against the carbon content. It is seen that from 3 per cent. C. upwards there is a marked reduction in the mechanical values. But the optimum rolling temperature does not appear to be much affected by the carbon content within the range investigated, so that for the complete range from 2.0 to 3.7 per cent. C a temperature range of 750 to 950 deg. C. can be inserted in the Fe-C diagram (Fig. 13). Comparison with the optimum rolling temperature for carbon steels quoted by H. Sedlaczek[11] indicates that the optimum temperatures for alloy cast irons correspond to those generally accepted for high-carbon steels.

Hot-rolling of Iron-carbon Alloys

Roll Design

In discussing the literature in a previous section, reference was made to the use of flat rolls in the early work on the rolling of cast iron, as compared with the Authors' use of grooved rolls. Very different stresses are applied to the material by these two types of rolls, for with flat rolls the reduction in height is the same in all transverse sections, while with grooved rolls the pressure is always non-uniform, a condition

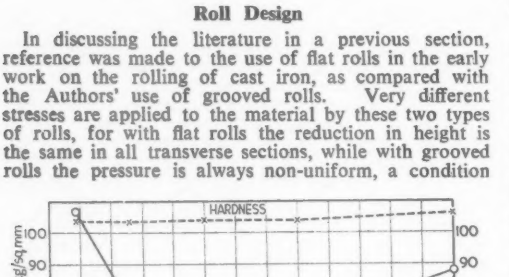

FIG. 10.—RELATIONSHIP BETWEEN MECHANICAL PROPERTIES AND PHOSPHORUS CONTENT.

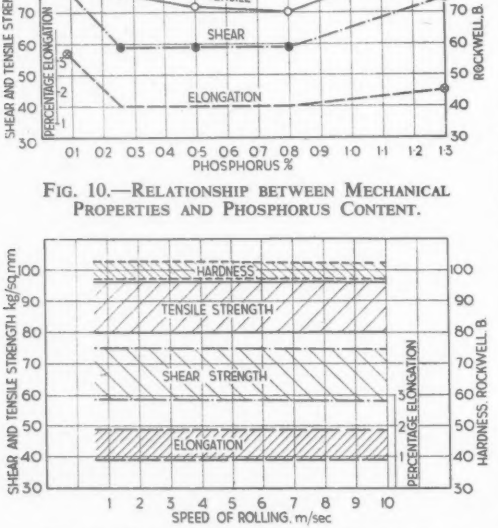

FIG. 11.—RELATIONSHIP BETWEEN MECHANICAL PROPERTIES AND SPEED OF ROLLING, 0.1 PER CENT. P.

which must be offset by displacing the material transverse to the direction of rolling.

It might therefore be expected that certain, *e.g.*, more or less graphitic, cast irons would be reasonably easy to roll between flat rolls, but give bad results with grooved rolls. This difference might already account for the results of earlier work in which it was found that grey and mixed irons could be economically rolled. Further work by the Authors has shown, moreover, that the mechanical properties of alloy cast irons of rolling quality are practically the same whether these are rolled between flat or grooved rolls; in only a few cases did grooved rolling give substantially higher physicals.

To get some idea of the permissible degree of deformation per pass, six series of bars of a rolling quality iron were rolled, omitting certain intermediate passes in each test to give a different degree of deformation per pass, the gross reduction being, however, the same in spite of the lower number of passes. Reductions from 0 to 33 per cent. showed that satisfactory deformation was obtainable only up to about 25 per cent. sectional reduction per pass, but this maximum reduction was permissible only when the cast structure of the bar had been eliminated by several low-reduction initial passes.

Mechanical tests showed, moreover, that in spite of a marked reduction in passes, the final mechanical values did not differ noticeably from those obtained with lower reductions per pass (Fig. 14). Roughly the same values were thus obtained with a total of five passes as with a total of 11 passes.

This work led the Authors to propose a slight modification in the roll design, as shown in Fig. 1 (lower half). This modified desgn gave the same total reduction as the original design, but in only eight passes instead of the initial 11 passes. In the new design, reductions are less in the first passes, gradually increase to 20 per cent., being again reduced in the last pass. A rectangle was selected for the cross-section of the final pass in order to reduce the wear at this part of the roll.

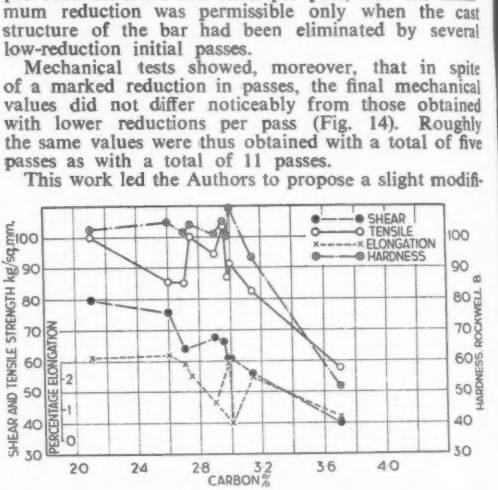

FIG. 12.—RELATIONSHIP BETWEEN MECHANICAL PROPERTIES AND CARBON CONTENT FOR 0.1 PER CENT. P.

Previous writers have already called attention to the marked improvement in mechanical properties which may be obtained by rolling, a result which has been confirmed in the Authors' present experiments. For example, the tensile strength of an iron containing 2.9 per cent. C, 1.3 per cent. Si and 0.1 per cent. P, increased from 28 kg. per sq. mm. before rolling to 110 kg. per sq. mm. after rolling, while the shear strength was raised from 37 to 76.5 kg. per sq. mm. and the elongation from 0.3 to 2 per cent. The

same improvement was found with the high-phosphorus alloys; bars with 2.6 per cent. C, 1.1 per cent. Si and 1.3 per cent. P, showed an increase in tensile from only 15 kg. per sq. mm. before rolling to 90 kg. per sq. mm. after rolling, while the shear strength was raised from 28 to 76 kg. per sq. mm. The elongation which could not be measured in the cast state was about 1 per cent. after rolling.

Two further series of experiments were carried out to determine the relationship between the increase in physicals and an increase in the degree of reduction and whether increasing the reduction during rolling limited the increase in mechanical values which could be obtained. Two heats of the same composition (2.8 per cent. C, 1.1 per cent. Si) were selected and differed only in the phosphorus values, *viz.*, 0.1 and 1.0 per cent. Bars of these heats were rolled at 850 deg. C. at 3 m. per sec., the first bars through the first pass only, the second through the first and second passes,

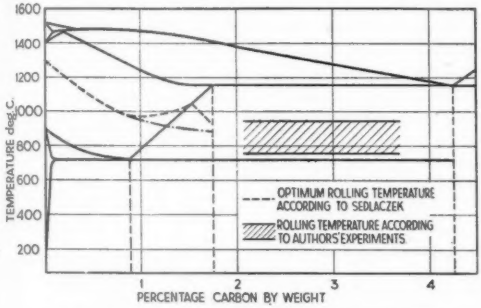
TEMPERATURE deg. C.
PERCENTAGE CARBON BY WEIGHT
OPTIMUM ROLLING TEMPERATURE ACCORDING TO SEDLACZEK
ROLLING TEMPERATURE ACCORDING TO AUTHORS' EXPERIMENTS

FIG. 13.—RELATIONSHIP BETWEEN PERMISSIBLE ROLLING TEMPERATURE AND CARBON CONTENT.

and so on. Test-pieces were taken from each bar for mechanical tests.

The results obtained are shown in Fig. 15. Apart from the hardness, the mechanical properties showed a sharp increase at the outset, attaining a maximum at 60 per cent. deformation. As expected, the hardness remained practically unchanged, since it is, after all, determined by the matrix which is substantially unaffected by rolling. It is seen that a deformation of 78 per cent., the maximum attainable with the type of rolls used, gave the maximum mechanical values.

Rolled Piston Rings

The work described here was carried out to explore the possibility of fabricating piston rings by rolling. A marked impetus to this work was given by the anticipated increase in the elastic and mechanical properties of the material as well as by the fact that rolling would displace the graphite perpendicular to the direction of travel. The apparent disadvantage of the relatively low carbon required to assure good rolling properties was largely offset by the tangential migration of the graphite in the rings during service.

Wear tests were made on a number of different wear-testing machines and gave abrasion values which compared satisfactorily with commercial grades of piston ring. Engine tests indicated a way of making piston rings of rolled cast iron which, with appropriate fabrication, structure and analysis, would have good running

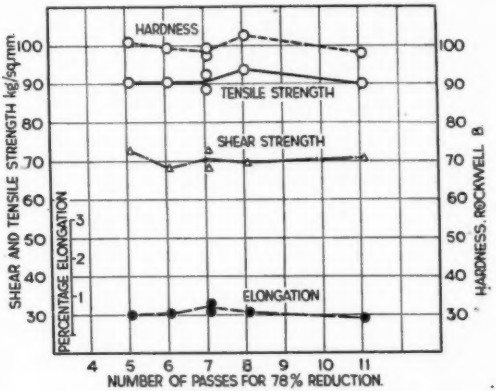

FIG. 14.—RELATIONSHIP BETWEEN MECHANICAL PROPERTIES AND NUMBER OF PASSES FOR EQUIVALENT DEGREE OF REDUCTION.

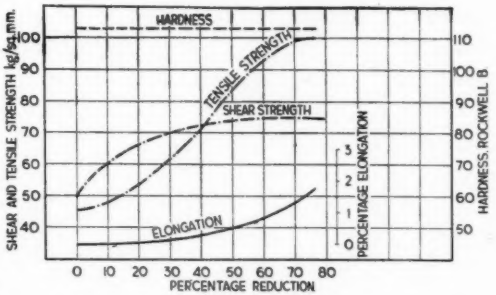

FIG. 15.—RELATIONSHIP BETWEEN MECHANICAL PROPERTIES AND PERCENTAGE REDUCTION AT 0.1 PER CENT. P.

qualities. Tests were made in both a single-cylinder engine and a six-cylinder engine, so that it was possible to compare the behaviour of the rolled rings with those of standard manufacture. The rubbing surfaces of both types of rings after the tests revealed no visible differences. These tests also showed that satisfactory piston rings could be fabricated from rolled cast iron and indicated future directions of development.

Hot-rolling of Iron-carbon Alloys

Summary

Systematic experiments have been carried out on the various factors entering in the hot-rolling of high-test cast irons. The best initial structure for cast iron of rolling quality was found to be a ledeburitic matrix, preferably without inclusions of free (primary) carbon (graphite). Grey and mixed irons did not respond to rolling, especially in grooved rolls. The presence of graphite carbon has practically no effect on the rolling qualities of the cast irons investigated.

As the rolling temperature is raised, the response to rolling and the mechanical properties improve, but deteriorate again rapidly from a temperature determined principally by the phosphorus content. Phosphorus values below 0.1 per cent. impart the best rolling properties, and give the maximum temperature interval within which plastic deformation is possible, as well as the highest mechanical properties; medium phosphorus values up to 0.8 per cent. adversely affect these properties, which, however, again show a small improvement at high phosphorus values (1.3 per cent.).

Speed of rolling in the range between 0.5 and 10 m. per sec. does not appear to affect the magnitude of the properties examined. Even with a white, graphitic initial structure, heats with over 3.0 per cent. carbon had lower mechanical properties. The optimum rolling temperatures on the other hand are independent of the carbon content between 2.0 and 3.7 per cent carbon.

Tests on roll design have led to a modified series of roll sections which promises to give a more uniform and more rapid reduction with less wear in the final pass.

How the mechanical properties are improved by the conditions of rolling was investigated in two series of tests, the relationship between mechanical properties and degree of deformation being clearly brought out. The maximum increase in mechanical values is obtained with a deformation of between 60 and 80 per cent.

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AERO RESEARCH, LIMITED, of Duxford, Cambridge, have now developed a resin-base core binder, carrying the trade name of "Resolite 103."

SEGMENTS FOR PATTERNS AND CORE BOXES

By "CHECKER"

When patterns and core boxes have to be built up with rows of segments, it should always be ascertained that the width of the wood used will be such that a large amount of scrap will not be left after cutting the segments out, and for this reason it may be advisable to first make a template to the true size of the segments required in either 3-ply or other thin wood, and then

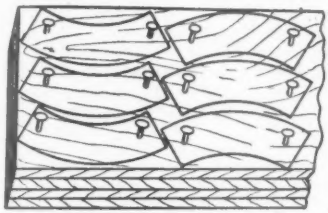

Fig. 1.—Manner of Marking Timber to Obtain Maximum Number of Segments.

select timber of the correct width, or the nearest available to eliminate waste. The template can be utilised for marking out the segments by placing it on the wood, and marking round it with a sharp pencil.

When, however, a large number of segments are required of the same size, it is not necessary to mark out each segment separately. Presuming that for a pattern to be turned in the lathe, 10 rows of segments are required with six segments to a row, that is 60 in all. Get out the timber in four pieces, each large enough to obtain 15 segments. Mark out the segments from the template on one piece only, and nail the four pieces of wood together with two nails in each segment, as shown in Fig. 1. Then saw out the segments and finish the ends to size on the sandpaper machine, or trimmer, and there will be 15 sets of four segments each, as shown in Fig. 2; withdraw the nails and the 60 completed segments are produced.

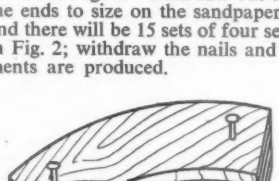

Fig. 2.—Set of Four Segments.

Considerable time can be saved by this procedure, as the 60 segments are produced by the operations for only marking out, sawing to size, and finishing the ends for one-quarter that number. If the required thickness of the segments is such that it is impracticable to nail them in fours, three or even two pieces of timber nailed together can still make it worth while.

Enamel Spraying Technique*

By A. J. Biddulph†

Spraying is essentially a process whereby fine particles of covering material are blown upon the ware in such a way as to produce a continuous coating over part or all of the surface.

In enamelling this method has certain advantages as compared with dipping. Intricate shapes can be covered, enamel thickness can be controlled more closely over a much wider range, selective parts of the ware can be coated, *e.g.*, one side of a plate; and often much more rapidly. Unless special spray heads are used, it is difficult to spray the interior of narrow shapes, and with all spraying there is some waste, often up to 50 per cent. of the material leaving the spray gun. Equipment for spraying is much more extensive and costly than for dipping.

Equipment Needed

The decision whether to dip or spray will depend upon consideration of these and other factors affecting the cost and grade of finish of the final product. The equipment for enamelling will include:—(1) Air compressor to deliver air at 60 lb. to 100 lb. per sq. in.; (2) storage tank, pipe line, and filters to remove oil and water; (3) spray gun; (4) enamel container (cup or pot with fluid hose); (5) spray booth; (6) exhaust system, and (7) dust extraction.

The compressor does not involve any special requirements, though oil-less lubrication is a great help in providing clean air. Compressors should be adequate to provide about 10 cub. ft. free air per minute for each spray gun to be used.

The pipe line should be of adequate diameter to prevent excessive pressure decrease by high friction losses, and it is an advantage also to have a pressure tank at the end of the pipe line to maintain a reserve against fluctuation in usage of air at the spray gun.

Filters should be adequate to the air they pass, and should be cleaned regularly and often. A dirty filter is is worse than no filter at all.

Spray Guns

The spray gun is the focal point of the whole spray system. It consists essentially of a means to supply a continuous feed of fluid through a controller orifice, and at the same time to control the supply of air at such a pressure so that the fluid may be divided into minute particles and blown in the required direction. This function is sometimes called "atomisation" for want of a better term.

Most, though not all, spray guns are of the type in which the centre line runs through the needle. The forward end of the needle results in an annular opening around the end of the needle, through which the enamel slip may pass forward. Around the fluid tip is the air cap, and between the two is an annular orifice through which air is blown forward. This movement of air adjacent to the fluid tip sucks the enamel slip forward with such an increased speed that the slip is broken up into tiny globules, each globule consisting of several pieces of frit with some clay, opacifier, electrolyte and water.

The size of the globule is a function of pressure and (*a*) quantity of air, (*b*) pressure, quantity and viscosity of the slip, and (*c*) the form and size of the air and slip orifices.

It is not proposed to give absolute values for these factors, even where they are determined, but to discuss in general terms the relation of the factors. Higher air pressure gives more complete disintegration and throws the material further forward. Greater quantity of air will induce a greater flow of enamel slip. Higher pressure on the slip will give greater flow, and thus result in greater quantity of slip. Higher "viscosity" of the slip will reduce the flow.

The thickness of the wall of the fluid tip governs the distance between the air and fluid orifices. This distance should be the minimum possible. The shape of the air orifice should be such as to give a conical jet of air whose point is about half an inch in front of the tip. If this distance be shorter, the resultant jet of slip globules will be wider, but the distance may be longer, in which case the jet will be narrower and its effective length will be greater. Dimensions and shape of the air and fluid orifices are fixed according to the model of the gun, but the enameller has a wide selection of models from which to choose.

Types of Gun

There are many different designs of spray gun, though nearly all conform to the description already given. Spray guns were used for paints and lacquers before enamels, and even to-day only a very small proportion of spray guns are used for enamel. Some manufacturers use specially hardened needles and fluid tips, and have modified their guns to suit enamel slip.

In practice, spray guns may be classified according to their purpose.

(*a*) Normal cone spray, usually 2-mm. needle, narrow air vent.

*A Paper presented to the Institute of Vitreous Enamellers.
†Ferro-Enamels, Limited.

Enamel Spraying Technique

(*b*) Normal fan spray, usually 2-mm. needle, narrow air vent.
(*c*) Mottling spray, usually 2-mm. needle, wide.
(*d*) Shading spray, usually 1-mm. needle, narrow.
(*e*) Cast enamel spray, usually 4½-mm. needle, narrow.
(*f*) Special types: forward extension, forward L extension, spinner gun, auto spray.

Containers

In early days each spray gun was fitted with a container to hold about a pint of enamel, and this "cup gun" still has a use in shops where single pieces are enamelled in different colours, or where only small amounts of enamel are used at one time. For general production, however, the cup is a source of much waste of time and enamel, and all up-to-date shops now use either gravity pots or pressure pots to hold between two and 40 galls. of slip.

The gravity pot is inexpensive to instal, and can be used in sizes up to five galls. with a single pulley hoist. Anything larger involves more complicated hoist mechanism, and is not of much advantage, as five galls. of enamel from gravity pots will last a sprayer four hours. A pressure pot will feed the enamel much faster, and with continuous spray a 40-gall. size can be utilised with advantage. Small pressure pots up to 5 galls. are often fitted with loose liners, so that the pressure pot itself does not require washing, and change of enamel can be effected by lifting out the empty liner and putting in a full one. Larger sizes are so weighty that they are no advantage, and the enamel is placed direct into the pot.

All pressure pots should be kept on platforms, either fitted with castor wheels, or suitable for transportation by a lift truck. For dissembling the pressure pot a simple one-pulley hoist should be available to lift the pressure head and keep it off the floor, and so avoid damage to the feed pipe, and the agitating paddle.

The outstanding advantage of the use of pressure pots is in the increased feed to the gun, and much greater speed of application, enabling the operator to produce from two to four times as much ware as with a cup gun, in a manual spray booth. This faster rate of production will, of course, necessitate the employment of experienced operatives or the reject figures will be excessive, but with close supervision, operatives can be trained in a short time to regulate their spraying to the conditions of pressure feed.

Spray Booth

The spray booth is essentially a cabinet, fitted with some sort of stand upon which the ware is placed during the spraying operation. The booth should have a system of exhausting to remove the dust caused during spraying. The size of the booth will be governed by the size of the ware and whether it is to be sprayed singly or in line. Many classes of ware can best be placed on a turntable, either manually, or electrically rotated. Any round ware should have an electric-operated turntable with good pad switch to increase output.

Flat ware, however, can often be more readily sprayed by being placed almost upright on a rack, so that the surface to be sprayed is normal to the direction of the spray jet. In this way a more even coating can be obtained, and the likelihood of rippling or orange peel effect is made more remote. The depth of the booth should be sufficient to give adequate room for the ware, without any of it protruding beyond the front edge, but the width should only be such as to allow free access in and out of the booth. Anything greater than this will cause decrease in the exhaust efficiency of the booth, or call for increased motor power.

Exhaust and Dust Extraction

These two subjects are very closely connected, and in more modern shops are dealt with together, though there are some shops where the former is practised to the minimum and the latter not at all. Exhausting the dust from the booth is necessary to prevent it fogging the whole shop and getting on to ware already coated in other colours. It is also desirable on account of the health of the operator, and there are some regulations under the Factories Act, which demand efficient exhaust. This is specified as 100 ft. per min. velocity across the face of the booth, and it is usual to budget for 120 ft.

Alternative methods include dry screens or bags, or water wash curtains, either of which may be incorporated in the single spray booth, or may be a separate installation to which exhaust air from several booths is led by ducting. Water wash booths were for a time favoured as being more efficient than dry dust extraction, but there are considerable difficulties due to wear on pumps, and cleaning of the system. To-day the tendency is a return to dry extraction, using screens instead of bags, in order to secure a much greater area of filtering surface. Whatever system is installed, it can only be fully effective if regularly cleaned out and maintained. This is a job that tends to be overlooked in many shops.

Operating Details

The spraying operation is most rapidly and efficiently performed if the ware is sprayed systematically whether it be a plain flat sheet or an intricate shape, spraying to a plan is to be desired rather than indiscriminate patching. The spray nozzle should be pointed so that the spray jet is normal to the ware, and should be moved so that the jet remains normal. This is achieved by moving the body as well as the arm, working from the waist, not from the wrist. Even steady strokes back and forth, with each stroke overlapping half of the previous stroke, produce even spraying.

When teaching operatives how to spray they should first be instructed how to cover a flat sheet of fired ground-coat by use of a cone spray of white enamel. Even strokes at regular intervals will be achieved by

practice, after which irregular shapes can be tackled, also with the cone spray. Later, when proficiency has been gained, a change to fan spray can safely be made.

Whatever the ware, a system of spraying should be established and maintained. Often it is found desirable to spray detail first, then plain surfaces, then edges. Edges provide an exception to the rule of keeping the spray normal to the surface. When edges of a horizontal plate are sprayed, the gun should be held below the level of the plate to prevent blowing the enamel down over the flange.

Recent Developments

Apart from manual spraying in the orthodox spray booth, modern developments include:—(*a*) Cable conveyor for flat ware, with manual spray; (*b*) cable conveyor for flat ware, with reciprocating automatic spray; (*c*) chain conveyor for cylinder exteriors with automatic spray; (*d*) monorail conveyor for irregular shapes, with manual spray; (*e*) cable conveyor for flat ware with electrostatic spray, and (*f*) rotor spray for cylinder interiors.

They are, of course, designed to spray specific types of ware, in fairly large quantities, but the general idea of continuous spraying can usefully be applied to many articles at present sprayed in manual booths. The cable conveyor with manual spray is good for all flat ware and can take flanges by suitable arrangement of the ware on the conveyor. It would have a speed of about 12 ft. to 15 ft. per min. and take ware up to 30 in. wide, thus producing 1,400 to 1,800 sq. ft. per hr., and requiring one man to load the conveyor, two men to spray and one man to unload from the exit end of the drier. The latter may also be a brusher.

A similar conveyor with automatic reciprocating spray heads has a speed of 20 ft. to 25 ft. per min. and an effective width of 3 ft. to 4 ft. producing about 4,000 sq. ft. to 5,000 sq. ft. per hr. One man loads the ware on to the cables and another unloads from the drier, while a third man supervises the spraying equipment, taking check weights twice an hour to ensure regular weight of application.

This set-up is good for flat sheets without flanges to be sprayed. If there are flanges, one or two men will be stationed either before or after the auto-spray to spray flanges, and the ware will be spaced more openly on the cables, the output being reduced by 10 to 20 per cent. of the pieces, though the area sprayed will probably be the same. The question of whether to place the flange sprayers before or after the auto-spray will depend upon the class of ware being handled, but they are usually placed after the auto-spray.

The chain conveyor for cylinder exteriors is useful for geysers and washing machine tubs. It carries the ware upright, and revolves it in front of the spray heads, later passing through the drying oven and back to the loading point, where one man unloads and reloads. Another man attends to the auto-spray.

The monorail for irregular shapes is probably the development which can bring the most improvement in output. The ware is hung from the conveyor and passes through a spray room or booth with a spraying face 20 or 30 ft. wide. Several sprayers placed at intervals along the spray face each spray one part of the ware according to a definite plan. A team of five men will spray 80 to a hundred 45-in. sink units per hour, or alternatively 100 to 120 refrigerator liners. This type of spray equipment is most effective when used on larger articles, when the vertical face presented to the operator is over 2 ft. high. Smaller ware can be sprayed, but would require a rather high chain speed, thus involving the sprayers in excessive movement.

Electrostatic Spray

The electrostatic spray has been used successfully for flat ware and is similar in general arrangement to the automatic cable spray, but the spray guns are arranged to direct the jet in a line parallel to the face of the ware, instead of normal to it. The electrical field through which the ware passes causes the enamel to deposit on the face of the ware. Plain flat plates, and plates with narrow flanges that do not require to be enamelled can be evenly coated by this method. It is also in use for coating both sides of ware in groundcoat.

In all these methods the installation is built in conjunction with a drying oven, and often is so located that the drier is unloaded adjacent to the furnace loading station, thus avoiding much of the handling that is common with manual spraying; thus costs of shop labour and of rejects from handling are minimised.

It may be suggested that these developments can only be applied usefully where very large production is required. While it is true that large production requirements can only be met by such installations, the more modest requirements of, say, 10,000 sq. ft. per week finished could well be met by a smaller edition of the flat ware cable spray before mentioned, with substantial saving in cost per article. Even if the plant were used only four hours per day, it would often show a saving on labour cost and general expenses.

One aspect of automatic and semi-automatic spraying which is of paramount importance is that it requires regular strict control of enamel, air, and speeds to ensure a standard sprayed coat at all times. With such control even coating and less thickness of enamel is achieved, and less enamel used, although this latter saving is less important than the improved appearance of the ware and lower reject figures.

DESPITE THE FUEL CUTS, the Western Light Castings Foundry Company, of Gowerton, Glam, are continuing to instal plant at the redundant Fairwood tinplate works, which they are converting into a foundry. Some of the plant is already in position, and it is planned to double the output of stove and grate fittings for new houses. The firm is also negotiating for a fully mechanised plant, but advanced delivery dates are compelling the management to use semi-mechanised machinery. Production at the new foundry will start by the end of this month.

GERMAN PRODUCTION OF SPUN PIPE*

By M. M. HALLETT*

The bulk of German pipe was produced in three main plants—at Gelsenkirchen, Wetzlar and Brebach-Saar. The first two of these plants employed the normal Delavaud process and the Saar plant used the sand-spun process. In general, no outstanding improvements since the plants were last visited in 1938 were encountered, and there were no indications that the processes were more efficient than those used in corresponding plants in Great Britain. Some points of interest were noted and are summarised below.

In view of reports of long life of the cupola linings, the practice was carefully checked. Fairly long runs of about 20 hrs. are normal and the lining life was quoted as six shifts, or about 600 tons of iron. The lining is then stripped back to the brick face and replaced by pneumatic ramming. Samples of the lining material were secured from Gelsenkirchen and from Wetzlar. The latter material appeared to contain extremely coarse particles of broken rock formation, whereas that from Gelsenkirchen was not so coarse, and the coarser particles seemed to be partly of pebble formation and partly of broken rock. Details of the analysis are given in Tables I and II.

TABLE I

Sieve Test (B.S.I.)	Sample from Gelsenkirchen	Sample from Wetzlar
	Per cent.	Per cent.
+ 10 mesh	11.4	39.1
10 to 16 mesh	1.1	1.4
16 ,, 22 ,,	3.0	0.6
22 ,, 30 ,,	3.3	1.0
30 ,, 44 ,,	4.8	1.1
44 ,, 60 ,,	10.4	1.8
60 ,, 72 ,,	6.8	2.0
72 ,, 100 ,,	14.6	6.3
100 ,, 150 ,,	13.7	10.0
150 ,, 200 ,,	6.3	4.6
200 ,, 300 ,,	5.1	4.8
— 300 mesh	19.5	27.2

TABLE II

Chemical Analysis	Sample from Gelsenkirchen	Sample from Wetzlar
	Per cent.	Per cent.
SiO	86.70	89.50
Al_2O_3	6.52	5. 7
TiO_2	2.23	0.28
Fe_2O_3	1.25	1.07
CaO	1.40	0.85
MgO	0.94	0.98
Loss on ignition	2.64	2.06
Alkalies	0.43	0.31

* Extracted from B.I.O.S. Final Report No. 700—"The German Centrifugal Castings Industry," by permission of the Controller of H.M. Stationery Office.

† Ministry of Supply.

Both materials are shown to be high in silica with some clay bond. The Wetzlar material is unusual in consisting mainly of a mixture of extremely coarse and extremely fine particles.

The casting machines were of normal design and known layout. One minor point of some operating value was the use of large dial weighing machines visible to the operating crews, on which each pipe was weighed immediately after extraction from the casting machine (Buderus).

At Gelsenkirchen the moulds, after use, were reduced to a smaller size by a cold "forging" operation under heavy hydraulic pressure. The process was not entirely satisfactory, and had been adopted because of inability to carry out the process in any other way.

At the Wetzlar plant of Buderus, flanged pipes were produced by the spun process for high-pressure applications. Another development was the centrifugal casting in dies of pipe flanges for screwing to double spigot pipes produced from scrap socket pipes. Details of the practice in the individual plants are given in the succeeding sections.

The Gelsenkirchen Plant

There are four cupolas, 10 to 12 tons per hr. capacity, each cupola being individually fitted with a Roots-type blower. The cupolas are brick-lined, with a pneumatically rammed lining 1 m. thick. This lining normally lasts six shifts in the melting zone without repair, when it is removed to the brick face and replaced with a new rammed lining. A split circular former is employed for this purpose, and the drying period after lining is 24 hrs., blast-furnace gas being used. The cupolas are open-topped, and for charging bottom-opening skips of 2 tons capacity are used. Slagging is continuous, but the cupola is tapped direct into shop casting ladles as required.

The metal is not treated in any way. The normal metal analysis is:—C, 3.4 to 3.5; Si, 2.0 to 2.5; Mn, below 0.5; S, 0.12 max., and P, O.7 to 0.8 per cent.

The plant consists of the following centrifugal casting machines:—One 300 to 500 mm. by 6 m., two 150 to 275 mm. by 5 m., three 80 to 150 mm. by 4 m., one 50 to 80 mm. by 3 m., and three 40 mm. by 2 m. These are the usual Delavaud water-box type, all machines being fitted with dual troughs.

The cores used consist of approximately 60 per cent. new sand, 30 per cent. burnt sand, and 3 per cent. sulphite lye. They are inferior to the normal English cores, having both a weak green and dried strength, the results of which are very evident in the resultant pipe.

Normalising.—Only one furnace is in operation, and is heated with blast-furnace gas. Prior to the war this was thermostatically controlled, but this apparatus is now out of service due to lack of spare parts and repairs. The pipes are in the furnace for about 30 min.,

and in the hot zone from 8 to 10 min., with a maximum pipe temperature of approximately 930 deg. C.

Fettling, Testing, etc.—There was nothing worthy of note in these departments, the bore of the pipe being ground in the normal way. So far as appearance went, the pipes were of poor quality, rarely straight, with very ragged and poor threads in the screwed-gland sockets, the sockets being frequently out of line with the pipe. The normal tensile test results are 18 tons per sq. in. for small pipes, 14 tons being the specified test.

Coating.—The dip was not in use, owing to damage to the heating coils. The dipping mixture consists of 70 per cent. medium hard pitch, 30 per cent. asphalt oil from which the fluid oils below 270 deg. C. have been extracted. The dip temperature is maintained at 120 deg. C., the pipes being preheated to 140 deg. C. and entering the dip at approximately 120 deg. C. The pipes are lowered and raised out of the dip at an angle of 60 deg., and remain in the dip for less than 1 min. From the dip they are rolled to a rack and again tilted at an angle of 60 deg. for approximately 20 min. to drain and cool. By this method 1,200 pipes of mixed sizes can be dipped in 9 hrs.

Reforging of Moulds.—Moulds up to 150 mm. are reforged at Gelsenkirchen, the method being similar to that in use at the Burlington plant, U.S.A. The mould is placed in a heavy casing, and is secured and sealed at the socket end, the spigot end being free to move lengthways without breaking the seal between the casing and the mould .A hydraulic pressure of from 30,000 to 37,000 lb. per sq. in. is applied for 15 to 25 min., and this reduces the diameter by approximately 6 mm., the mould recovering by 1 mm. on removal of the pressure. A pressure of 37,000 lb. per sq. in is required for an 80-mm. mould, lower pressures being used on the larger and thinner moulds.

A mould life of only approximately 30 per cent. of the original life is obtained from these squeezed-in moulds. The people concerned do not appear very happy about the process, which was adopted as they were unable to persuade anyone to carry out reforging on their behalf. A satisfactory sealed joint for the spigot end of the mould has yet to be designed, and they have endless trouble through collapse and leakage with this joint during pressing operations.

During the war period nickel for moulds was unobtainable and the following substitute analyses have been used:—(1) C, 0.30; Cr, 1.8, and V, 0.10 per cent. These moulds give extremely poor results (2) C, 0.30; Cr, 1.8 and Mo, 0.30 per cent. These moulds were an improvement on the first. The life to-day is, for 150-mm. moulds, 1,000 to 1,200 pipes.

The Halberger Hütte Plant

No additions or changes have taken place to this plant since it was visited in 1938. It is undamaged, and could be put on full production when the necessary power is available and the Government consent to the coke ovens being lighted. The sand spun process is employed, and the greater part of the plant consists of conveyors, etc., for the mixing and conveying of the sand used in this process. The only noteworthy feature of the machines was the fact that the hoppers are provided with dial weighing machines, and are filled with the correct amount of metal required for the size of pipe being manufactured.

Normally the iron is obtained from a 100-ton mixer in proximity to the blast furnaces, but at the present time cupolas are in use. There are three of these, each of 10 tons per hour capacity. Owing to the distance of the cupolas and mixer from the casting plant, a minimum temperature of 1,380 deg. is required to give a casting temperature of 1,330 deg. In this process no trough is used, the metal being introduced with the mould revolving at approximately 25 r.p.m., the machines being brought up to full speed as rapidly as possible when pouring is completed. About 1,300 r.p.m. is the speed for 100-mm. pipes, and 600 r.p.m. for 400-mm. pipes, other sizes being in this ratio.

The pipes examined were rough in the bore and would appear to need considerable grinding to obtain a good inside, but the pipes in general were far below British standard. A screwed-gland is used with round threads, which were crude and looked extremely inefficient. The pipes are furnace heated to a temperature of 120 deg. prior to dipping. (M. Jannot considers this method more expensive than the hot-water heating used at Pont-à-Mousson). The pipes only remain in the dip for half-a-minute, the dip being maintained at 100 deg. C. The dipping mixture consists of 52 per cent. pitch, which was stated to contain 4.8 per cent. bitumen, and 3 per cent. naphthalene, the balance being made up of:—

Oil	Boiling Point, deg. C.	Per cent.
Light	180	Nil
Light	180 to 200	1
Fairly light	200 ,, 240	15
Medium	240 ,, 270	8.8
Anthracene	270 ,, 350	23.2

The specific gravity of the mixture is 1.185.

The pipe analysis is:—C, 3.5 to 3.8; Si, 1.8 to 2.0; Mn, 0.4 to 0.5; S, 0.1, and P, 1.2 to 1.4 per cent.

The Brinell hardness is 180 to 220, and the tensile strength is of the order of 13 tons per sq. in.

Practice of Buderus'sche Eisenwerke

Cupolas.—There are four cupolas, two of 10-ton capacity per hour, which will run singly or in any pair combination to give the required output. These cupolas are lined with an extremely coarse local high silica material (see earlier section for details), pneumatically rammed to a former, the top 4 ft. of the cupola being finish faced with cast-iron bricks. The lining in the heat zone has a normal life of 500 tons without repair, after which the face of this portion is removed, and a new lining rammed in place. Charging is by a 2-ton bottom opening skip, the whole equipment being one-man controlled, electrically operated.

Spun plant.—The plant consists of the following centrifugal Delavaud machines:—One 300/500 mm. x 6 m., one 200/250 mm. x 6 m., one 200/250 mm. x 5 m., one 150 mm. x 6 m., one 150 mm. x 5 m., one 100 mm. x 5 m., one 70/80 mm. x 4 m., one 60/80

German Production of Spun Pipe

mm. x 4 m., one 40 mm. x 3 m., four 40 mm. x 2 m.

The machines are motor driven, with open gearing, the mould being supported by three sets of rollers. The traverse and tilting gear are self-contained and are oil operated, each machine having its own electric oil-pressure pump. Traverse motion is transmitted to the water box by rack and pinion. Each machine is also provided with a dial weighing machine, the aim being to manufacture pipes of the minimum weight for the class manufactured. The pipe crews are paid a special bonus on low weight returns. All machines are fitted with dual troughs, but it is difficult to see that these have any advantage in the larger machines.

Tests.—A sample of the metal for analysis is taken each day before 9 a.m. and no chill or fluidity tests are made. Two physical tests per week are taken. They state that no others are necessary, and their rapid production of small pipes, and lack of normalising troubles are entirely due to the good quality and consistent characteristics of their pig-iron.

Cores.—All cores are made in cast-iron rings, which are machined to fit the moulds and are the only portion of the core in actual contact with the mould. About 30 per cent. of burnt sand is used, the balance being new sand bonded with sulphite lye.

Normalising.—The normalising furnace is 20 m. x 6½ m., heated with blast furnace gas, 1,000 calories per cub. m. (one quarter the calorific value of towns gas), the consumption being from 4 to 5,000 cub. m. per hr., with an output of 50 tons of normalised pipes per hour. These are in the furnace from 25 to 35 mins., are in the hot zone for 10 mins., at a pipe temperature of 910 to 920 deg. C. They leave the furnace at 750 deg., are immediately ground, and dipped as rapidly as possible. Re-normalising is almost unknown.

Dip.—Pipes enter the dip at approximately 100 to 120 deg. C. and the dip was being maintained at this temperature. The pipes remain in the dip for half to one minute. The dip itself is heated with steam coil, superheated steam at 220 lb. per sq. in., the dipping mixture consisting of 70 per cent. medium hard pitch and 30 per cent, asphalt oil, from which the fluid oils below 270 deg. C. have been extracted. After dipping, the pipes are immediately racked at 60 deg. and allowed to drain and cool for 20 mins. before being placed on the gantries for despatch.

Flanged pipes.—Flanged pipes are manufactured by the spun process and are used for high pressure work. The normal standard socket type of mould is used, except that whilst the outside profile of the mould is unaltered, the socket profile of the inside of the mould is left solid and is machined to the contour of the flange. When this flange face has lost its useful life, the mould is then bored out to the normal socket contour and used as a standard mould.

In making the flanged pipe, no sand socket core is used, a hematite plate being the mould for the flange

(*Continued at foot of next column.*)

face, and the results are so perfect that it is unnecessary to machine this face, the flange only being drilled after casting. The spigot end of the pipe is cut to length, screwed slightly taper, and the loose flange screwed and shrunk on.

Socket and spigot pipes scrapped due to socket faults are cut off to double spigot pipes, a flange screwed on both ends, and sold as flanged pipes. The flanges used for this purpose are also centrifugally cast, a hematite mould being used for this purpose. Here again the castings are so good that they only require boring, screwing and drilling, the face again being unmachined. The life of these hematite moulds is from 300 to 500 flanges.

Dipping Mixtures

In discussing dipping in general, Dipl-Ing. Hans Schlumberger, Gelsenkirchen Bergwerks A.G., Bergbau Gruppe, Gelsenkirchen, stated he considers that taste will always occur if naphthalene is present, and every endeavour should be made to eliminate this from the mixture. It also occurs with tars and pitch and oils distilled at low temparatures, the minimum of which should be 270 deg. The dipping mixture he recommends should consist of 65 per cent. pitch, 35 per cent. oils, and this proportion should be consistently maintained, the pitch never exceeding 70 per cent.

When the most suitable specific gravity of mixture has been obtained, a hydrometer should be constantly used, and the correct specific gravity adhered to. Heavy anthracene oil should be used—maximum 2 per cent. at 270 deg., as the use of lighter oils renders the mixture unstable at varying temperatures.

Pipes should never exceed 200 deg. C. when entering the dip, the temperature of which should be carefully maintained at 120 deg. They should not be artificially cooled, but should be allowed to fume, as again unstable coating will result if cooling is too rapid. The time the pipe is in the dip depends entirely on the temperature of the pipe entering the dip, and if these temperatures are similar, half-a-minute will give perfect results.

INSTITUTE OF VITREOUS ENAMELLERS

The quarterly meeting opened at the Café Royal, Regent Street, London, W., last Thursday, with a Paper by Mr. Cameron. Mr. Grainger introduced to the meeting the new chairman of council, Mr. W. H. Aston, who thereafter presided.

Mr. Cameron's Paper recounted the way he had overcome many difficulties in the manufacturing processes of refrigerator making. A good discussion followed.

After luncheon, Mr. McLeod told of the creation of a central library and asked for greater use to be made of the services available. The afternoon was spent visiting the research laboratories and glassworks of the General Electric Company at Wembley. A further discussion was held on Dr. Partridge's "Conference" Paper on "Glass to Metal Joints."

NEWS IN BRIEF

ADDITIONS ARE BEING MADE to the works of the Darlington Railway Plant & Foundry Company, Limited.

A. C. WICKMAN, LIMITED, have adopted the five-day working week. In future, their offices and works will be closed on Saturdays.

THREE NEW BRANCHES have been formed by the Institution of Incorporated Plant Engineers at Manchester, Leeds and Newcastle-upon-Tyne.

THE EMPLOYEES OF THE Grahamston Iron Company, Limited, of Falkirk, collected and distributed £429 to the district hospitals during 1946.

SHOTTS IRON COMPANY, LIMITED, have disposed of their Clippens Limestone Works at Loanhead, Midlothian, to Bairds & Scottish Steel, Limited.

THE ENTIRE STAFF of Matthew Swan, Limited, of Railway Foundry, Newton Heath, Manchester, were the guests of the company at a New Year's tea party followed by a visit to a circus.

AS A FIRST STEP in an effort to stimulate interest in the preservation of the relics of early engineering in the Midlands, the Newcomen Society is to make a survey of all historical plant or records in the area.

HENDERSON ENGINEERING COMPANY, LIMITED, announce that, owing to termination of lease, and until their new works at Bishopbriggs are completed, they have transferred to temporary works at 117, Fordneuk Street, Bridgeton, Glasgow, S.E.

WILD-BARFIELD ELECTRIC FURNACES, LIMITED, in collaboration with E. S. Mowat & Sons, who have been their agents in South Africa for many years, have formed a company registered in the Union, bearing the name Wild-Barfield (South Africa) (Pty.), Limited, with registered offices at 51, Milne Street, Durban, Natal.

ON JANUARY 25, eight employees, three women and five men, of Gibbons (Dudley), Limited, received presentations in recognition of their long service. Each of them has been with the firm for over half a century. The presentations, silver teapots for the three women and gold watches for the men, were made by Mrs. Gibbons, wife of Lt.-Col. W. E. Gibbons, chairman of the company, in the works canteen at Lower Gornal, Worcestershire.

A SOMEWHAT UNUSUAL GATHERING took place recently when the governors and senior members of the staff of Markham & Company, Limited, Broad Oak Ironworks, Chesterfield, entertained the local directors of the company at dinner. Mr. W. Moore (chief draughtsman) took the chair and proposed the toast of the guests, which was responded to by Messrs. R. J. Barclay (managing director), F. Williams (works director), and T. K. Shaw (director).

THE BRUSH ELECTRICAL ENGINEERING COMPANY, LIMITED, intend to submit a scheme shortly involving a complete merger with oil engine companies whose products are sold by Associated British Oil Engines, Limited. Four of these companies—Mirrlees, Bickerton & Day, J. & H. McLaren, Oil Engines (Coventry), and Petters, Limited—are already controlled by Brush; their combined capital is about £750,000. If consent is given, proposals will be put before Brush shareholders in due course.

PERSONAL

MR. ANDREW REID MCCOSH has been elected a director of Bairds & Scottish Steel, Limited.

MR. RICHARD H. STONE, sales manager of the Vesuvius Crucible Company, Pittsburgh, has been appointed chairman of the 1946-47 refractories committee of American Foundrymen's Association.

MR. HUGH A. H. MCGILL has been appointed a director of Textile Machinery Makers, Limited, following his appointment as managing director of the new company, Platt Bros. (Sales), Limited.

MR. C. G. A. TAYLOR, works manager of the Llanelly tinplate works of Richard Thomas & Baldwins, Limited, has been appointed general manager in succession to MR. H. W. WHEATSTONE, who has retired after 52 years' service.

MR. HARRY YATES, managing director of Smith & McLean, Limited, sheet and bar rollers, has been elected vice-president of Glasgow Chamber of Commerce. He has represented the Scottish Steel Makers' Federation in the Chamber since 1941.

MR. J. KNIGHT has been appointed by Wycliffe Foundry & Engineering Company, Limited, and Follsain Metals, Limited, to handle their malleable-iron castings and other products for the whole of Scotland. His address is 21, Wellshot Drive, Cambuslang, Glasgow.

MR. J. P. LONGMUIR, who has been appointed Director of Welfare by the National Coal Board, has been general welfare officer to Newton Chambers & Company, Limited, since 1942, prior to which he was welfare officer to Mavor & Coulson, Limited. At Newton Chambers' works he has been largely responsible for superintending the scheme of apprentice training. The first training centre was opened shortly after Mr. Longmuir's arrival, and since then the works college has been extended to business training, engineering, mining, foundry practice, etc.

Will

WILSON, E. A., managing director of Evered & Company, Limited, brassfounders. Smethwick, Staffs £131,948

THOS. W. WARD, LIMITED

A note published in a recent issue regarding the acquisition by Thos. W. Ward, Limited, of the Birchley Rolling Mills, Limited, gave the impression that Mr. H. W. Secker is chairman and managing director of Thos. W. Ward, Limited. Mr. Ashley S. Ward is, of course, chairman of Thos. W. Ward, Limited, and Mr. George Wood and Mr. Frank R. Stagg joint managing directors. Mr. Secker's chairmanship in this connection should, of course, have referred only to Birchley Rolling Mills, Limited.

ORGANISATION OF INDUSTRY

INCREASING EFFICIENCY AND PRODUCTIVITY

The Industrial Organisation Bill, introduced in the House of Commons last week, will enable effect to be given to major recommendations of the working parties set up by the Government to consider the better organisation of certain important industries. The purpose of the Bill is to enable the Minister in charge of a Department such as the Board of Trade, the Ministry of Supply, the Ministry of Fuel and Power, and certain others, after consultation with the workers and employers in an industry, to establish for that industry a central body, referred to as a development council. The general objects of such councils will be to increase the efficiency and productivity of their industries and to enable them to render better and more economical service to the community. An Order setting up a development council may authorise the council to collect statistical information of a type and in a form approved by the Minister concerned and to collect a levy for the purpose of financing its activities, at a rate not exceeding the maximum laid down in the Order. The Minister concerned may collect a levy from an industry for which no development council exists, if he considers it necessary that finance should be made available for the promotion of scientific research, the development of exports or the improvement of design, in that industry. The money collected will be paid into a public fund or account and will be issued from it to the appropriate industrial bodies. Accounts giving details of the collection and disposal of sums under arrangements of this kind must be laid annually before Parliament.

Functions of Development Councils

The functions which may be assigned to development councils are outlined in a schedule to the Bill as follow:—

(1) Promoting or undertaking scientific research.

(2) Promoting or undertaking inquiry as to materials and equipment and as to methods of production, management and labour utilisation, including the discovery and development of new materials, equipment and methods and of improvements in those already in use, the assessment of the advantages of different alternatives, and the conduct of experimental establishments and of tests on a commercial scale.

(3) Promoting or undertaking research into matters affecting industrial psychology.

(4) Promoting or undertaking measures for the improvement of design, including promoting or undertaking the establishment and operation of design centres.

(5) Promoting the production and marketing of standard products.

(6) Promoting the better definition of trade descriptions and consistency in the use thereof.

(7) Undertaking the certification of products, the registration of certification trade marks, and the functions of proprietors of such marks.

(8) Promoting the training of persons engaged or proposing engagement in the industry, and their education in technical or artistic subjects relevant thereto.

(9) Promoting the adoption of measures for securing safer and better working conditions, and the provision and improvement of amenities for workers, and promoting or undertaking inquiry as to such measures.

(10) Promoting or undertaking research into the incidence, prevention and cure of industrial diseases.

(11) Promoting or undertaking arrangements for encouraging the entry of persons into the industry.

(12) Promoting or undertaking research for improving arrangements for marketing products.

(13) Promoting or undertaking research into matters relating to the consumption or use of goods and services supplied by the industry.

(14) Promoting arrangements for co-operative organisations for supplying materials and equipment, for co-ordinating production, and for marketing products.

(15) Promoting the development of export trade, including promoting or undertaking arrangements for publicity overseas.

(16) Promoting or undertaking arrangements for better acquainting the public in the United Kingdom with the goods and services supplied by the industry and methods of using them.

(17) Promoting the improvement of accounting and costing practice and uniformity therein, including in particular the formulation of standard costings.

(18) Promoting or undertaking the collection and formulation of statistics.

(19) Undertaking arrangements for making available information obtained in the exercise of any of the functions outlined above.

IN PARLIAMENT

Copper and Zinc Supplies

LT.-COMMANDER HUTCHINSON asked the Minister of Supply what arrangements were being made to supply copper and spelter to manufacturers whose stocks exceeded six months' consumption.

MR. WILMOT said that following discussions with representatives of the copper- and zinc-using industries, the total tonnage of unwrought copper which a firm might hold had now been increased to the equivalent of seven months' consumption. The Ministry's purchase arrangements would not permit a similar increase in the case of zinc. Firms whose holdings of metal were in excess of those permitted quantities had been informed that they might resume taking orders.

Mechanised Foundries

MRS. MANNING asked the Minister of Supply how many foundries in England and Scotland had turned over from floor moulding to the mechanised production of builders' light castings.

MR. WILMOT: Approximately 55 per cent. of the principal foundries engaged in the production of builders' light castings are wholly or partially mechanised.

THE MODERN PIG

IF YOU WANT...
clean iron, free from sand, free from sows ...uniform analysis... convenient size...easy handling... specify
STANTON MACHINE CAST PIG IRON

SPECIFICATION

WEIGHT	80-90 lbs.
Length	22 inches
Width	8½ inches
Thickness	3¾ inches

(at notch 2½ inches).

Made in our well-known
STANTON, HOLWELL & RIXONS BRANDS

THE STANTON IRONWORKS COMPANY LIMITED NEAR NOTTINGHAM

CONTRACTS OPEN

Any date given is the latest on which tenders will be accepted. The address is that from which forms of tender may be obtained.

Huyton, February 20—Pipes, gullies, cast-iron manhole covers and gulley grates, etc., for the Urban District Council. Mr. A. W. Thomas, engineer and surveyor, Council Offices, Huyton.

Macclesfield, March 3—Iron castings, for the Borough Council. Mr. J. H. Dossett, borough engineer, Town Hall, Macclesfield.

Stockport, February 15—Spun-iron straight and cast-iron special pipes, etc., for the Town Council. The Secretary, Water Department, Town Hall, Stockport.

Stockport, February 22—Iron castings, etc., for the County Council. Mr. W. F. Gardner, borough sur-Secretary, Water Department, Town Hall, Stockport.

Stoke-on-Trent, February 13—Cast-iron work, cast-iron pipes and specials, etc., for the Corporation. The City Surveyor, Town Hall, Stoke-on-Trent.

Tredegar, February 11—1,200 yds. of 12-in. cast-iron pipes with specials, for the Urban District Council. Mr. S. L. Filer, gas engineer and manager, Gas Department, Poplar Road, Tredegar, Mon.

Turton, February 24—Cast-iron gulley grates and manhole covers, for the Urban District Council. Mr. R. Dart, engineer and surveyor, Council Offices, Bromley Cross, near Bolton.

Twickenham, February 22—Iron castings, street gullies and drain pipes, etc., for the Borough Council. Mr. A. S. Knolles, borough engineer and surveyor, Municipal Offices, Twickenham.

Wolverhampton, February 17—Iron castings, for the County Council. The Borough Engineer, Town Hall, Wolverhampton.

Wortley, February 26—Iron castings, for the Rural District Council. Mr. J. Gregory, engineer and surveyor, Council Offices. Grenoside, Sheffield.

NEW PATENTS

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patent)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1*s. each.*

581,625 SOC. ANON POUR L'INDUSTRIE DE L'ALUMINIUM. Manufacture of furnaces for the electrolytic production of aluminium.

581,659 AVELING-BARFORD, LIMITED, and BRAMBLE, W. H. Self-propelled tipping wagons.

581,700 GENERAL MOTORS CORPORATION. Making porous metal articles.

581,706 HIGH DUTY ALLOYS, LIMITED, and WARRINGTON, H. G. Aluminium base alloys.

571,758 INTERNATIONAL COMBUSTION, LIMITED, and SMITH, H. A. Positioning refractory tiles and the like.

581,777 UNITED STATES PIPE & FOUNDRY COMPANY. Centrifugal casting machines.

581,888 ADELINE, P. Production of steel and alloys.

581,902 SHELL DEVELOPMENT COMPANY. Execution of catalytic conversions in the presence of ferrous metals.

581,903 BRITISH NON-FERROUS METALS RESEARCH ASSOCIATION, BAILEY, G. L., and HALLOWES, A. P. C. Production of copper alloys.

581,912 JACK & HEINTZ, INC. Cylinder castings.

581,964 STANDARD TELEPHONES & CABLES, LIMITED, and STOCKS, H. R. Magnetic means for the hardness testing of metals.

582,009 OKONITE-CALLENDER CABLE COMPANY, INC. Improving the physical properties of lead.

582,026 DU PONT DE NEMOURS & COMPANY, E. I. Protection of metal surfaces.

582,040 COMPAGNIE DE PRODUITS CHIMIQUES ET ELECTROMETALLURGIQUES ALAIS, FROGES ET CAMARGOE. Manufacture of beryllium and its alloys.

582,132 SOC. ANON. DES ACIERIES ET FORGES DE FIRMINY. Process for hot-rolling very long thin strips.

582,163 BAILEY, R. W., BURTON, H. H., WINDER, A. B., METROPOLITAN-VICKERS ELECTRICAL COMPANY, LIMITED, and ENGLISH STEEL CORPORATION, LIMITED. Casting metals.

582,236 ALEXANDER, W. O., and IMPERIAL CHEMICAL INDUSTRIES, LIMITED. Copper-chromium alloys.

582,293 ALLOTT, N. E. Hot-rolling of metals and alloys.

582,340 SANKEY & SONS, LIMITED, J., and HANCOX, F. A. Sheet metal building sections.

582,386 INTERNATIONAL CORRODELESS, LIMITED, and TAYLOR, R. W. Passivation of zinc and cadmium surfaces, including electro-galvanised, galvanised zinc sprayed, zinc plated and cadmium plated surfaces.

582,417 BRITISH DRIVER-HARRIS COMPANY, LIMITED (Driver Harris Company). Deep resistant alloys.

582,450 AMERICAN CYANAMID COMPANY. Concentration of non-sulphide iron ores.

582,451 STEVENS, A. H. (Electro-manganese Corporation). Electro-winning of manganese.

582,551 AVERY, LIMITED, W. & T., and HINDE, P. B. Hardness-testing machines.

582,554 ENFIELD ZINC PRODUCTS, LIMITED, and GRIMSTON, J. Manufacture of seamless zinc cans for dry batteries.

NEW TRADE MARKS

The following applications to register trade marks appear in the "Trade Marks Journal":—

"TEXTILATIE"—Textile machinery. JONES TEXTILATIES, LIMITED, Audley Range Mill, Blackburn.

"HABIB"—Abrasive tools. IMPREGNATED DIAMOND PRODUCTS, LIMITED, 6-7, Kingston Buildings, Bath.

"MECHANAIR"—Air compressors. G. & C. METAL COMPANY, 1068, Warwick Road, Birmingham, 27.

"DUROPAK"—Pipes and tubes, sheets, foil, etc. VENESTA, LIMITED, Vintry House, Queen Street Place, London, E.C.4.

"TAVITOME"—Large-size agricultural implements. J. T. WHITTOME & COMPANY, 3, Parkwood Road, Tavistock, Devon.

CHEMISTRY TO THE AID OF MODERN INDUSTRY

With linseed oil now in short supply, formulators of core oils will find exceptionally interesting possibilities in

DUTREX

a new product which can be used to replace as much as 50% of the linseed oil normally used.

●

DUTREX (formerly Group 1-72) is a brown oil, compatible with vegetable and mineral oils, and costing about one-fifth as much as linseed oil at current prices. We shall be glad to receive enquiries regarding its application to specific cases, and to collaborate in securing the best results in practice.

●

TECHNICAL PRODUCTS LTD

NEW ADDRESS: 112 STRAND, LONDON, W.C.2. TELEPHONE: TEMPLE BAR 4455
MANCHESTER OFFICE: 4 ST. MARY'S PARSONAGE, MANCHESTER 3: BLACKFRIARS 0097

PIG-IRON AND STEEL PRODUCTION IN GREAT BRITAIN

STATISTICS FOR NOVEMBER

The following particulars relating to pig-iron and steel production in Great Britain have been extracted from the Statistical Bulletin for December, 1946, issued by the British Iron and Steel Federation. Table I gives the production of pig-iron and ferro-alloys in November, with the number of furnaces in blast at the end of the month; Table II, production of steel ingots and castings in November; and Table III, deliveries of alloy and non-alloy finished steel. Table IV summarises the activities of the steel industry as a whole during the six months ended November, 1946.

TABLE I.—*Weekly Average Production of Pig-iron and Blast-furnace Ferro-alloys in November*, 1946. (*Thousands of Tons.*)

District.	Furnaces in Blast, 30.11.46	Hematite.	Basic.	Foundry.	Forge.	Ferro-alloys.	Total.
Derby, Leics., Notts., Northants and Essex	26	—	16.1	20.4	1.4	—	37.9
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Ches. / Yorkshire (incl. Sheffield, excl. N.E. Coast)	5	—	6.3	—	—	0.7	7.0
Lincolnshire	12	—	19.0	—	—	—	19.0
North-East Coast	26	5.9	30.3	0.5	—	1.9	38.6
Scotland	10	0.6	8.8	2.4	—	—	11.8
Staffs, Shrops., Worcs., Warwick	5	—	3.9	1.1	—	—	5.0
S. Wales and Monmouthshire	7	2.8	18.2	—	—	—	21.0
North-West Coast	7	11.9	—	1.7	—	—	13.6
Total	98	21.2	102.6	26.1	1.4	2.6	153.9
October, 1946	99	21.0	105.0	24.9	1.6	3.3	155.8
November, 1945	99	22.0	106.6	17.6	0.9	2.9	150.0

TABLE III.—*Weekly Average Deliveries of Alloy and Non-alloy Finished Steel.* (*Thousands of Tons.*)

Product.	1944.	1945.	1945.	1946.	
			Nov.	Oct.	Nov.
Non-alloy steel :—					
Heavy rails, sleepers	6.5	7.1	8.4	7.8	7.6
Heavy and med. plates	30.8	26.4	30.5	34.9	34.4
Other heavy products	38.2	33.1	30.3	35.5	33.9
Light rolled products (excl. wire rods and alloy-steel bars)	46.2	41.9	48.6	54.2	55.7
Ferro-concrete bars	2.1	1.8	2.6	3.0	3.1
Cold-rolled strip	4.2	4.0	3.8	4.7	4.9
Bright-steel bars	4.9	3.9	3.7	5.5	5.2
Sheets, coated and uncoated	21.2	20.2	21.4	24.8	23.4
Tin, terne, blackplate	10.0	9.5	9.8	12.4	12.3
Tubes and pipes	12.3	10.9	11.9	15.4	16.0
Steel wire	12.2	10.2	11.1	12.4	12.6
Tyres, wheels, axles	2.6	2.5	3.0	4.1	3.8
Forgings	5.9	5.3	4.6	4.9	5.5
Castings	5.1	4.1	3.1	3.2	3.3
Total	202.2	180.9	192.8	222.8	221.7
Alloy steel :—*					
Plates	1.9	1.1	0.4	0.1	0.2
Tubes and pipes	0.6	0.3	0.1	0.2	0.4
Bars, sheets, strip and wire	5.6	3.0	2.7	3.4	3.8
Drop forgings	3.0	1.6	1.1	1.6	1.4
Other forgings	2.0	0.6	0.5	0.4	0.5
Castings	1.7	0.9	0.6	0.7	0.5
Total	14.8	7.5	5.4	6.4	6.8
Total U.K. production†	217.0	188.4	198.2	229.2	228.5
Less Intra-industry conversion	24.5	17.8	18.8	20.1	20.1
Total net U.K. deliveries	192.5	170.6	179.4	209.1	208.4
Add Deliveries of imported finished steel	5.0	1.0	—	—	—
Total deliveries of finished steel	197.5	171.6	179.4	209.1	208.4

* Excludes high-speed steel.
† Includes finished steel produced in the U.K. from imported ingots and semi-finished steel.

TABLE II.—*Weekly Average Production of Steel Ingots and Castings in November*, 1946. (*Thousands of Tons.*)

District.	Open-hearth.		Bessemer.	Electric.	All other.	Total.*		Total ingots and castings.
	Acid.	Basic.				Ingots.	Castings.	
Derby, Leics., Notts., Northants, and Essex	—	—	(Basic) 9.7	0.9	0.4	10.5	0.5	11.0
Lancs. (excl. N.W. coast), Denbigh, Flints. and Ches. / Yorkshire (incl. Sheffield, excl. N.E. coast)	0.8	21.6	—	0.5	0.4	22.4	0.9	23.3
Lincolnshire	—	24.2	—	—	0.1	24.2	0.1	24.3
North-East Coast	3.5	47.3	—	0.6	0.5	50.5	1.4	51.9
Scotland	6.2	29.6	—	0.9	0.6	35.7	1.6	37.3
Staffs., Shrops., Worcs. and Warwick	—	13.4	—	0.5	0.6	13.5	1.0	14.5
S. Wales and Monmouthshire	7.7	41.3	(Basic) 5.0	0.7	0.1	54.5	0.3	54.8
Sheffield	9.4	21.9	—	6.7	0.5	37.0	1.5	38.5
North-West Coast	0.2	3.5	(Acid) 4.4	—	—	8.0	0.1	8.1
Total	27.8	202.8	19.1	10.8	3.2	256.3	7.4	263.7
October, 1946	24.5	198.2	18.1	10.3	3.2	247.0	7.3	254.3
November, 1945	23.6	191.3	19.5	9.4	3.1	240.2	6.7	246.9

* Including alloy.

(*Continued at foot of page* 146.)

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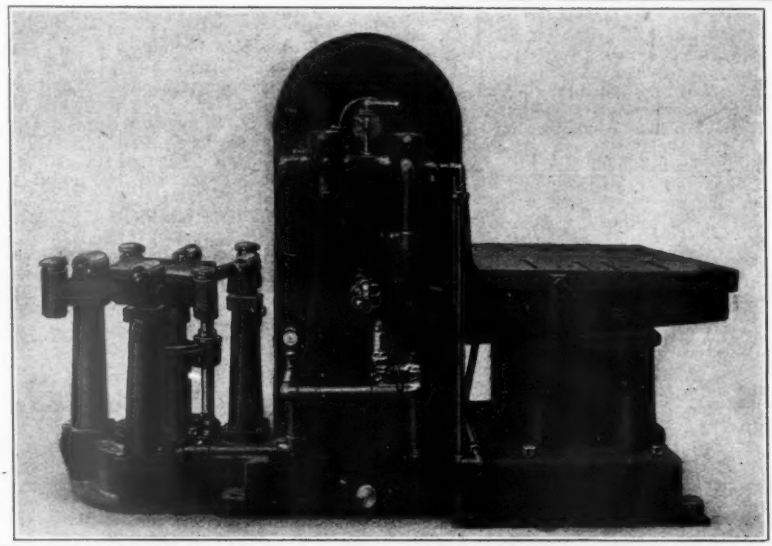

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OBITUARY

MR. WILLIAM P. FLEMING, of Glasgow, retired steelworks manager, died on January 25.

MR. WILLIAM M'GAVIN, secretary of William Morgan & Company, Limited, engineers and crane builders, of Kilwinning, died in Glasgow on January 22, aged 61.

MR. JAMES FOSTER-SMITH, managing director of the Wellman Smith Owen Engineering Corporation, Limited, died on January 24 at his home in London. He had directed the affairs of the Wellman Corporation for more than 25 years. Mr. Foster-Smith was 66 years of age. From his early youth his main interest was engineering. After completing his technical education at Glasgow University, he entered the service of the Glasgow Crane & Hoist Company, later joining the staff of Appleby & Company, crane builders. His first association with the Wellman companies was in 1904, when he took up an appointment as chief engineer of Wellman Seaver & Head, Limited, and was engaged on the early development of steelworks handling machinery in this country. In 1912 he entered the service of Babcock & Wilcox, Limited, as engineer-manager of the crane department. On resigning this position after a few years, he formed the James Smith Hoisting Machinery Company, Limited. In 1919 his company joined forces with Wellman Seaver & Head, Limited, and the Wellman Smith Owen Engineering Corporation, Limited, emerged with Mr. Foster-Smith in the chief executive position as managing director. From that time his whole energies were devoted to the development of the corporation's business and the improvement of British practice in the design and construction of steelworks machinery and metallurgical furnace plant. It was largely through his enterprise and foresight that the design and manufacture of seamless-steel tube-making plant was brought to a high degree of perfection in this country, setting a lead to the rest of the world. Out of this process, new shell-making methods emerged which proved of immense value to Britain in the war. Mr. Foster-Smith travelled widely and made many friends. He was an officer of the Order of St. John of Jerusalem, and a liveryman of the Girdlers' Company and the Founders' Company. He was a member of the Institution of Mechanical Engineers and of the Iron and Steel Institute.

SHEFFIELD METALLURGICAL ASSOCIATION

At the annual meeting of the Sheffield Metallurgical Association, held on January 21, Mr. T. F. Russell, of the English Steel Corporation, Limited, was inducted as the new president. Other officers elected for 1947 were:—Vice-presidents, Dr. C. Sykes, F.R.S., and L. Rotherham, Thos. Firth & John Brown, Limited; A. Roebuck, Hadfields, Limited, and E. T. Gill, Edgar Allen & Company, Limited; hon. treasurer, T. H. Arnold, Hadfields, Limited, and hon. secretary, P. Jubb, Thos. Firth & John Brown, Limited. The following members of council were also appointed:—W. Lister, Kayser, Ellison & Company, Limited; T. R. Walker, English Steel Corporation, Limited; E. J. Vaughan, Admiralty Laboratory, Sheffield; Dr. J. White, University of Sheffield; H. Hicks, Sheffield Forge & Rolling Mills Company, Limited; B.E.G.R. Wilkinson, Firth-Vickers Stainless Steels, Limited; T. H. Cole, Jonas & Colver (Novo), Limited; F. W. Tetley, Levick (Swift) & Sons, Limited; G. E. Speight, United Steel Companies, Limited, and G. Wood, Hadfields, Limited.

The Hatfield Prize for the best Paper presented by a member was presented by Mrs. Hatfield to Mr. J. A. McWilliam, Firth-Vickers Stainless Steels, Limited. After the election of officers, the president gave an address describing possible metallurgical fields for research in the future, including phase changes in iron and in carbon steel, their modification by pressure, and internal stresses in metals.

UNION STEEL OF SOUTH AFRICA

The directors of the Union Steel Corporation (of South Africa), Limited, recommend that the capital of the company be raised from its present level of £850,000 to £1,450,000 by the creation of 2,400,000 new ordinary shares of 5s. each. A meeting to consider resolution to this effect will be held on February 27 in Johannesburg. The additional capital is required to finance the modernising and expansion of plant.

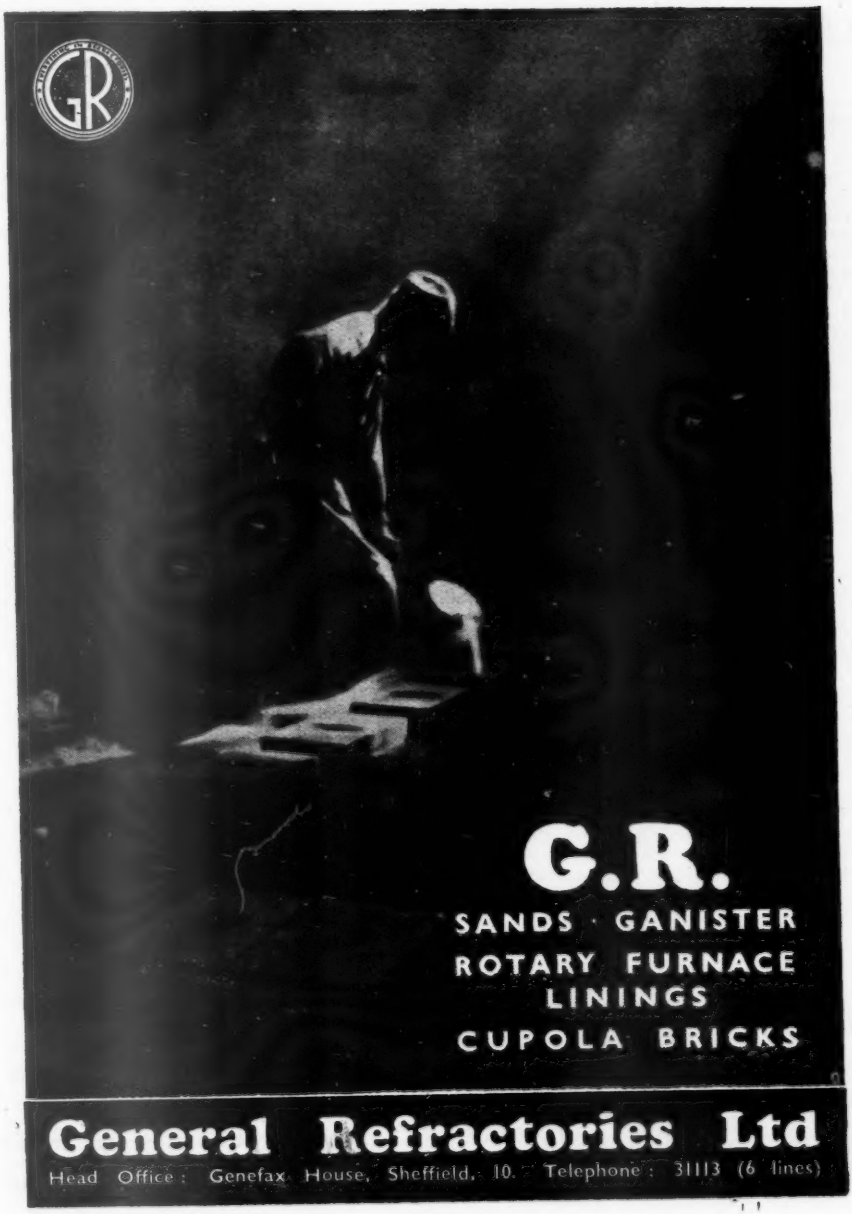
THE UNION FOUNDRY, LIMITED, is being wound up voluntarily. Mr. J. Hudson, Acresfield, Bolton, is the liquidator.

PIG-IRON AND STEEL PRODUCTION IN GREAT BRITAIN (*Continued from page* 144.)

TABLE IV.—*General Summary of the Pig-iron and Steel Industry.* (*Weekly Averages in Thousands of Tons.*)

Period.	Iron-ore output.	Imported ore consumed.	Output of pig-iron and ferro-alloys.	Scrap used in steel-making.	Steel (incl. alloy). Imports.	Output of ingots and castings.	Deliveries of finished steel.	Steel stocks held by producers, etc.*
1944	297.6	46.8	129.5	141.7	26.6	233.5	197.5	2,171.0
1945	272.5	77.2	136.7	138.5	2.9	227.3	171.6	1,683.9
1946—June	225.5	118.7	151.5	142.9	9.0	239.8	191.8	1,130.7
July	220.3	119.4	147.0	137.5	6.5	226.1	176.6	1,160.6
August	223.6	118.9	145.3	134.9	10.2	226.0	172.9	1,198.9
September	229.3	118.4	147.3	144.8	13.3	238.5	207.7	1,186.8
October	230.2	126.3	155.8	153.6	10.8	254.3	209.1	1,103.9
November	221.7	127.3	153.9	160.0	8.7	263.7	208.4	1,073.0

* Stocks at t he beginning of the years and months shown.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Raw Material Markets

IRON AND STEEL

The cut in fuel supplies to the blast furnaces will undoubtedly have the effect of reducing outputs of foundry pig-iron, and this in turn will slow down supplies to the foundries. The reduction in the fuel allocations does not apply to the foundries themselves, which is fortunate, for heavy demands are being made upon them. The light foundries, using mainly high-phosphorus pig-iron, are heavily committed for a long time ahead. Light castings are needed for housing requirements and for many other trades. Any reduction in the quantity of castings delivered to the building industry would hold up the housing programme, as very heavy supplies will be wanted in the early spring.

Large quantities of high-duty castings are now called for by many trades, including machine-tool makers, general engineers, textile machinery manufacturers, etc., and a substantial tonnage of pig-iron of the better grades is essential to meet expanding outputs at the engineering and jobbing foundries. The position in respect to pig-iron supplies was tight before the recent cut in fuel allocations, there being particular stringency in high-phosporus pig-iron, and now there is heavy pressure for hematite and low- and medium-phosphorus iron. There is a big market abroad for pig-iron which, unfortunately, cannot be supplied.

Foundry scrap requirements are now exceptionally large, for more scrap is being used owing to the restricted supply of pig-iron. The engineering and jobbing foundries want both steel and cast-iron scrap and heavy tonnages of light and medium scrap are needed by the light foundry trade. It is to be hoped that the satisfactory position which has obtained for some time will be maintained.

Shortage of wagons and the railway embargoes are still preventing the easy flow of supplies to consumers, and this not only affects foundry coke and pig-iron, but also ganister and limestone. The recent bad weather has had its effects in the extraction of the last two. The engineering foundries are getting all they require in the way of ferro-alloys.

The re-rollers of bars, light sections, casement bars, strip, etc., are not well placed for raw material. There is a definite shortage of billets and blooms, and because of it the re-rollers are unable to obtain maximum outputs. This is unfortunate, as their order books are full and they need maximum production if they are to give consumers reasonable deliveries. There is little likelihood of the position changing materially in the near future. Some supplies of semis are coming through from abroad, but they are very small. The home makers are despatching every ton they can, but even the larger supplies which have been forthcoming from the English and Welsh makers do not make up for the lack of imports, and the fuel cut is certain to make the position even less secure. Every use is being made of old rails and other forms of steel which can be put to useful purpose in re-rolling, but, unfortunately, the supplies of defective billets, crops, and the like, are not plentiful.

Certain steelworks have advised their customers that as a result of the cut in allocations of fuel, supplies of steel to users must be diminished. All steelworks have heavy commitments in joists, sections and plates, more than they will be able to manage over the next two periods, and many consumers have already specified certain of their requirements for Periods III and IV. There have been drastic cuts in the supplies of heavy steel for export because of this heavy drain on the steelworks' resources for essential home requirements.

NON-FERROUS METALS

Details of copper consumption in the United Kingdom during December, which have been issued by the British Non-ferrous Metals Federation, show a fall of about 3,000 tons in virgin metal on the November figure, which was not surprising in view of the incidence of the Christmas holidays. The actual figures are 28,836 tons of virgin copper used in December and 14,631 tons of scrap (copper content). For the year 1946 the corresponding totals are 325,409 tons and 168,307 tons. For the fourth quarter, consumption of virgin copper in this country was at the rate of about 31,000 tons per month.

The American Copper Institute's statistics for December reveal that production of crude, or blister, copper in December was 78,140 short tons, against 73,020 tons in November, while in refined the corresponding totals were given as 77,578 tons and 75,066 tons. Stocks of refined declined to 80,832 tons at December 31, against a figure of 90,896 tons at November 30. There was a big rise in domestic deliveries to 148,218 tons from 129,206 tons in November, this figure suggesting that some 60,000 tons were provided from M.R.C. stocks.

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